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A PCA approach to stellar effective temperatures ⋆

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ABSTRACT

Context. The derivation of the effective temperature of a star is a critical first step in a detailed spectroscopic analysis. Spectroscopic methods suffer from systematic errors related to model simplifications. Photometric methods may be more robust, but are exposed to the distortions caused by interstellar reddening. Direct methods are difficult to apply, since fundamental data of high accuracy are hard to obtain.
Aims. We explore a new approach in which the spectrum is used to characterize a star's effective temperature based on a calibration established by a small set of standard stars.
Methods. We perform principal component analysis on homogeneous libraries of stellar spectra, then calibrate a relationship between the principal components and the effective temperature using a set of stars with reliable effective temperatures.
Results. We find that our procedure gives excellent consistency when spectra from a homogenous set of observations are used. Systematic offsets may appear when combining observations from different sources. Using as reference the spectra of stars with high-quality spectroscopic temperatures in the Elodie library, we define a temperature scale for FG-type disk dwarfs with an internal consistency of about 50 K, in excellent agreement with temperatures from direct determinations and widely used scales based on the infrared flux method.

Key words. Stars: fundamental parameters — Catalogs — Techniques: spectroscopic

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1. Introduction

The photons we measure from a star provide information on the regions they were last emitted or scattered from, i.e. the atmosphere of the star. Accordingly, it is this shallow layer that matters for modeling and understanding a stellar spectrum. Stellar spectra are described with three basic atmospheric parameters: effective temperature ($T_{\rm eff}$), surface gravity ($\log g$), and overall metallicity ([Fe/H]). The effective temperature corresponds to the temperature of a black body with the same total radiative energy of the star:

$$F = \int_{-\infty}^{\infty} F_\nu d\nu = \sigma T_{\rm eff}^4. \quad (1)$$

In addition to the basic atmospheric parameters, we can infer a lot of information about a star from its spectrum, most notably its chemical composition from the strength of absorption lines associated with different elements.

There are several ways to approach the task of determining the effective temperature of a star. One is by comparing the observed spectral energy distribution with model calculations (see, e.g., Ramírez et al. 2006). Another possibility consists in using photometric calibrations, such as those based on the infrared flux method (Blackwell & Lynas-Gray 1998; Alonso et al. 1996, 1999; Casagrande et al. 2010).

The flux at the stellar surface (F at a distance equal to the stellar radius R) and that at the Earth (f at a distance d from the star) satisfy

$$FR^2 = fd^2. \quad (2)$$

Based on this property, the most straightforward method of deriving effective temperatures corresponds to measuring the bolometric flux of a star and its angular diameter ($2R/d$) and to using them with the Stefan-Boltzmann law (Eq. 1). This method is, however, technologically challenging due to the tiny apparent sizes of stars in the sky – the nearest solar-like stars at merely a few pc from us are only a few milliarcseconds in diameter. Nevertheless, the Center for High Angular Resolution Astronomy (CHARA) array measurements (McAlister et al. 2005; ten Brummelaar et al. 2005) and other projects (Mozurkewich et al. 2003; Kervella & Fouqué 2008) have provided us with angular diameters with unprecedented quality for many giants and a handful of dwarf stars.

In this paper we introduce a new method of inferring the effective temperature of a star. Our procedure is inspired by the work by Cayrel et al. (2011), who derive effective temperatures by modeling the Hα line, correcting for systematic errors by linearly mapping their temperatures to a scale based on angular diameters and absolute fluxes. We condense the information on $T_{\rm eff}$ contained in stellar spectra using principal component analysis (PCA). Then we map the principal components onto $T_{\rm eff}$s based on a set of reliable calibration stars. Once the calibration is performed,

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⋆ Tables 2, 4 and 5 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/

we can easily derive temperatures for other stars observed with the same instrument.

Since our procedure takes as input data continuum-normalized high-resolution spectra, it is immune to distortions in the spectral energy distributions due to interstellar reddening. Unlike χ^2-fitting certain parts of the spectrum with high sensitivity to Teff, such as the Balmer lines, by using models, PCA is optimized to make use of all the information on the stellar effective temperature contained in the spectrum.

This paper is divided into five sections. Section 2 provides details of the libraries that we use in our work, and the PCA analysis we performed on them. Section 3 describes how we calibrate a relationship between PCA coefficients and stellar effective temperatures. Section 4 presents our results and Sect. 5 compares them with other temperature scales from the literature. In Sect. 6, we apply our preferred PCA transformation to more than 18,000 spectra from the Elodie archive. Finally, Sect. 7 gives a summary of the work and our conclusions.

2. The spectral libraries

Among the many spectral libraries available in the literature, we have selected two that cover quite homogeneously the entire visible range (from 390 to 680 nm): Elodie and S^4N. As described below, these two libraries differ fundamentally in two aspects: their spectra were obtained with different instruments and processed independently, and they focus on different types of stars. S^4N considers only stars in the immediate solar neighborhood, with distances to the Sun smaller than about 15 pc, whereas Elodie includes more distant stars.

2.1. Elodie

The Elodie library contains 1959 spectra of 1388 stars acquired with the Elodie spectrograph installed in the 1.93 m telescope at the Observatoire de Haute-Provence (France) (Prugniel & Soubiran 2001; Prugniel et al. 2007)[1]. The spectra on the library have a signal-to-noise ratio (SNR) between 100 and 150. They cover the range between 3100 K to 50000 K in effective temperature, -0.25 to 4.9 in $\log g$ (with g in cm s^{-2}) and -3 to $+1$ dex in [Fe/H][2]. Histograms of these quantities are presented in the upper panel of Fig. 1.

The spectra have a resolving power $R = \lambda/\delta\lambda = 42000$, with the flux normalized to a pseudo-continuum. We have performed our analysis both at a resolving power of $R =$ 10000 and 1000, finding slightly better results at lower resolution. Smoothing and resampling the spectra can only destroy information, but it is also possible that it helps reducing the impact of high-frequency instrumental distortions in the data. Working at low resolution offers additional advantages, since the computational effort required is signicantly smaller and opens up the application of the method to lower-resolution instruments.

In order to degrade the spectral resolution, we smear the spectra using Gaussian convolution [3]. Additionally, we ensure that all spectra have a consistent continuum normalization. Each spectrum is fitted with an 8-th order polynomial. Data points for which the residual between the original spectrum and the fit are beyond 0.5 standard deviations below or 3 above the mean are discarded. This procedure is iterated ten times until the fit is close to the upper envelope of the spectrum. This process is arguably not optimal for locating the true stellar continuum, but it is consistently applied to all spectra.

Additional filtering is necessary, since some of the spectra show unwanted features, such as emission peaks or instrumental distortions, or correspond to outliers (for instance, when temperature is outside the range considered in our analysis). To filter the data we first discard all spectra with emission peaks greater than 1.2 times the continuum and absorption features deeper than 0.1 times the continuum flux. After that we apply PCA to the spectra that have passed the first filter, and keep only those for which the difference between the spectra reconstructed with the first 5 principal components and the original spectrum is under 5%. This ensures that we are picking up "regular" stars which share properties with the rest of objects in the sample. That leaves us with a final set of 1245 spectra. In what follows we refer to this set of spectra as "Elodie".

The atmospheric parameters of the Elodie stars (from the online database) have been obtained from a compilation of high resolution spectroscopic analyses in the literature. When multiple values are available from different sources, the library catalog adopts a weighted average, giving preference to data with smaller errors. The goal is to end up with a homogeneous set of values for all parameters. Quality flags (Q) are assigned to each parameter value according to the level of agreement across different sources. The better the agreement, the larger the quality flag. $Q_{T\mathrm{eff}}$ ranges from -1 to 4; in this scale, 1 corresponds to the lowest and 4 to the highest quality, being -1 and 0 special cases for internal determination of the effective temperature[4], and values derived from $B-V$ colors[5], respectively.

2.2. S^4N

The S^4N library by Allende Prieto et al. (2004) includes spectra obtained with the Tull spectrograph (Tull et al. 1995) on the 2.7 m telescope at the McDonald Observatory of the University of Texas at Austin, and FEROS, the Fiber-fed Extended Range Optical Spectrograph (Kaufer & Pasquini 1998) attached (at the time) to the 1.52 m telescope at the European Southern Observatory (La Silla, Chile). It includes 119 spectra of 119 stars (including the spectrum of the blue sky as a proxy for the Sun), which have a SNR of 150-600, and a resolving power $R \simeq 50000$. It covers the range of -0.9 to 0.5 in metallicity, 1.9 to 4.7 in $\log g$ and 4158 K to 7646 K in effective temperature, as illustrated in the lower panel of Fig. 1.

[1] For more detailed information check the webpage `http://www.obs.u-bordeaux1.fr/m2a/soubiran/elodie_library.html`

[2] [X/H] = log (N(X)/N(H)) - log (N(X)/N(H))$_\odot$, where N(X) represents the number density of nuclei of the element X.

[3] With the `gconv` IDL code available at `http://hebe.as.utexas.edu/stools/`

[4] Determined with the TGMET software by Katz et al. (1998).

[5] Assuming the empirical color-temperature relation for a main sequence star and neglecting interstellar extinction, using to the Tycho2 I/259 catalog.

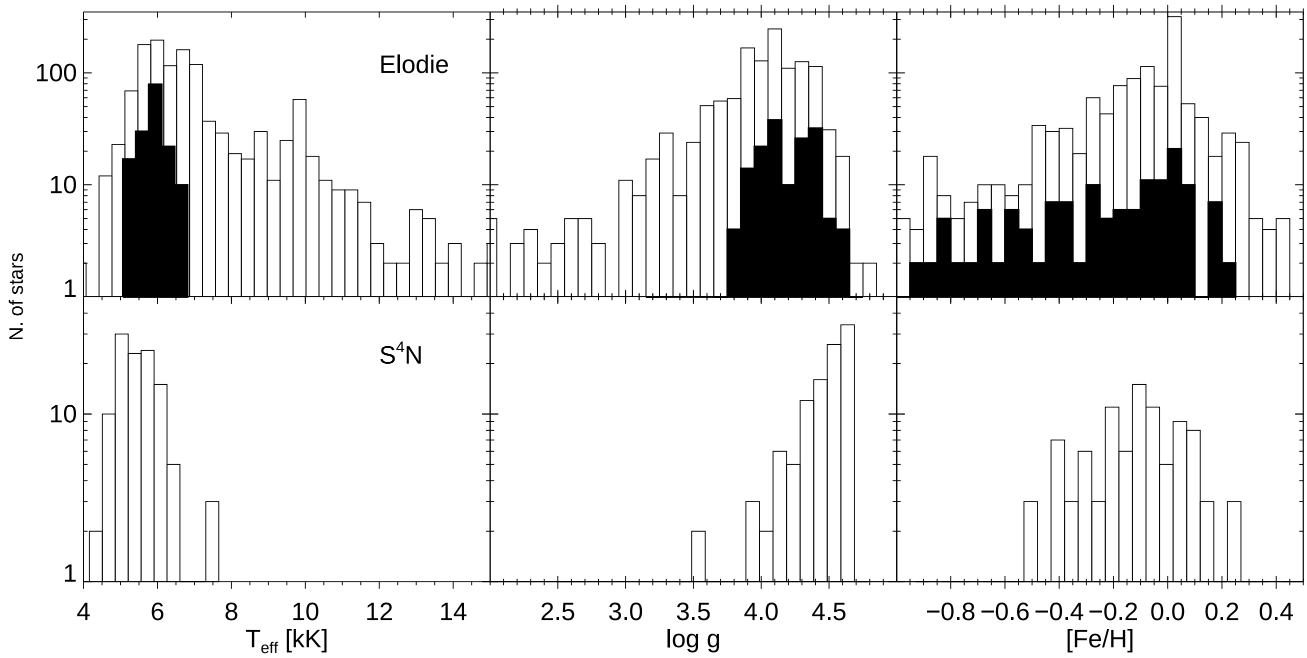

Fig. 1. Elodie (upper panel) and S^4N (lower panel) stellar parameters for all spectra in the sample. In the upper panels, the subsample of the Elodie library with the highest quality effective temperatures ($Q_{T_{\rm eff}} = 4$) is shown with filled-in black bars.

For consistency with the Elodie dataset, we have used the same wavelength grid and the same smoothing algorithm in S^4N, resulting in a final resolution of $R = 1000$. Likewise, exactly the same continuum normalization process has been applied to the S^4N spectra.

The original atmospheric parameters for the S^4N library stars were obtained using several methods. The effective temperatures were calculated with the infrared flux method (IRFM) calibrations described by Alonso et al. (1996). We have recalculated the temperatures with the more recent $B - V$ and $b - y$ calibrations by Casagrande et al. (2010), adopting the latter as we explain in Section 5. The $\log g$ values were obtained with stellar evolution models, from the effective temperatures (derived from the Alonso et al. calibration) and the parallaxes measured by the Hipparcos mission (Perryman & ESA 1997), which are accurately known for all the S^4N stars. The metallicity was then obtained by spectroscopic means, using $T_{\rm eff}$ and $\log g$ as known parameters.

2.3. Combination

Both Elodie and S^4N are spectroscopic libraries obtained with echelle spectrographs. Nevertheless, the instruments and the data processing are different in each case. We first attempted to use the full spectral region discussed in the preceding sections, but the results were significantly poorer than those for a single library. Therefore, we found it important to choose appropriate spectral windows instead of the entire wavelength range, so that the existing differences between libraries do not affect our results. The presence of the sought-after information in the spectra is a must, but nearly every feature in the spectrum responds to Teff, and PCA is designed for the very purpose of condensing such information. The discrepancies between the two libraries are dominated by instrumental or atmospheric (telluric) distortions.

The root mean squared error (rms) between two different stars in the same library (all wavelengths) is about 3%, whereas the mean difference between two different spectra of the same star in the same library is about 1% (derived from stars observed more than once in Elodie).

To select the wavelength regions that we consider in common for both surveys, we apply the following simple algorithm based on the fact that Elodie and S^4N have 29 stars (and the same number of spectra) in common. Calculating the mean difference for those 29 spectra, we get what we can call a “mean difference spectrum” which is displayed in Figure 2. Then, we selected the regions where this mean difference is small. The mean rms of the spectra we have in common in our spectral range is 0.8 % (under 1%, which can be considered as a suitable threshold because this is the largest difference between different spectra of the same star in one of the databases). This criterion leads to the shaded regions in Fig. 2, that correspond to the windows [4449,4907] Å, [5237,6134] Å and [6368,6790] Å.

2.4. PCA analysis

Principal component analysis is an algebraic and statistical tool which aims at finding the directions of largest variance in the data. Given a set of stellar spectra, we can apply PCA to them and describe each spectrum with far fewer numbers than the original data. In order to arrive at the new set of numbers (the principal components; PCs), we adopt a new basis set formed by the eigenvectors of the correlation matrix, and order them by decreasing eigenvalues. With just the projection of the data into the first 10 elements of the base we can reproduce optical low resolution spectra with a very small error (less than 2% in most cases). Not

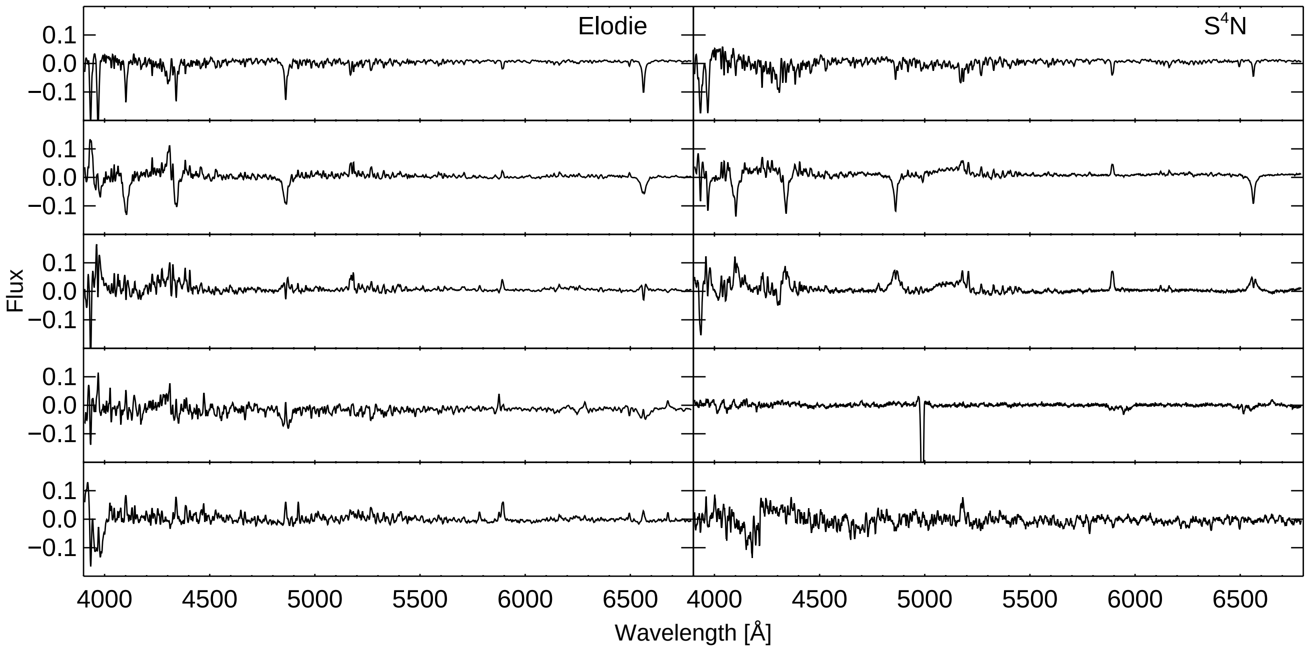

Fig. 3. First 5 eigenvectors (ordered top to bottom) of the Elodie (left column) and S^{4}N (right column) databases.

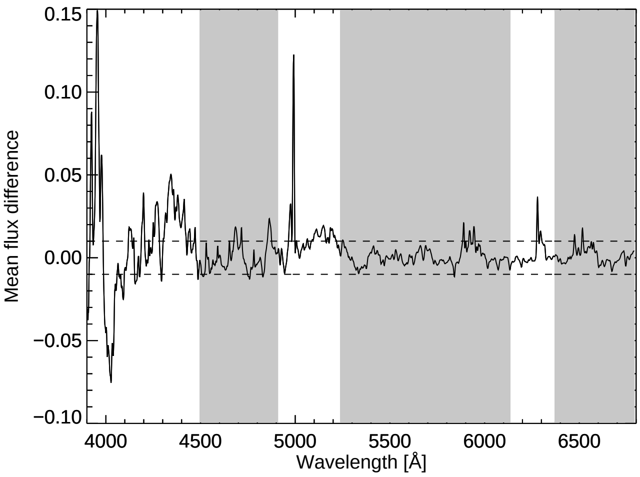

Fig. 2. Mean difference spectrum between Elodie and S^{4}N for the 29 stars in common in both surveys. The dashed horizontal lines mark ±1% and the shadowed regions indicate the regions that we consider for the combined analysis of both databases.

only is PCA a powerful compressing algorithm, but it also gives us information about the data.

We apply PCA and retain the first N principal components for each star in the sample; we typically work with ∼10. Then we look for a calibration between the principal components of a subset of stars (the calibrators) and their effective temperatures. Finally, we use that calibration to infer the temperature of the rest of stars (test).

As a brief reminder of the procedure to compute the principal components, let us assume that the $m \times n$ matrix of data $\mathbf{Y}$ is built by stacking as rows the spectra of size m of all the n stars considered, where the average spectrum

$$m(\lambda_j) = \frac{1}{n} \sum_{i=1}^{n} Y_i(\lambda_j), \tag{3}$$

with $j = 1 \dots m$, has been subtracted from each observation. From the zero-mean data, we compute the correlation matrix:

$$\mathbf{C} = \mathbf{Y}\mathbf{Y}^T \tag{4}$$

and we diagonalize it. Note that it may be desirable to diagonalize the matrix $\mathbf{Y}^T\mathbf{Y}$ (along the observation direction, instead of the wavelength direction) if this has smaller dimensions. It is simple to transform back and forth from the eigenvectors in one representation to the other by appropriately multiplying by the data matrix $\mathbf{Y}$ (see, e.g., the discussion in Martínez González et al. 2008). The eigenvectors computed so far represent the directions in the space of spectra where we find the largest correlation. The first 5 eigenvectors obtained for Elodie and S^{4}N are displayed in Fig. 3. Interestingly, we find that the fourth eigenvector of S^{4}N contains a conspicuous peak at ∼ 5000 Å. We believe this to be residuals from narcissus in one of the spectrographs, the *picket fence* described by Tull et al. (1995).

Figure 4 shows the first 20 principal components for the first star of each library (HD 245 in the case of Elodie and the Sun in the case of S^{4}N). As usual, they tend to decrease because the first PCs contain the most important information of the spectrum. The calibration we develop below builds on the data shown in Fig. 5, which shows the relationships between $T_{\rm eff}$ and the first five principal components. Since these relations are, in general, not linear, more complicated expressions are necessary. This is discussed in Section Sect. 3.

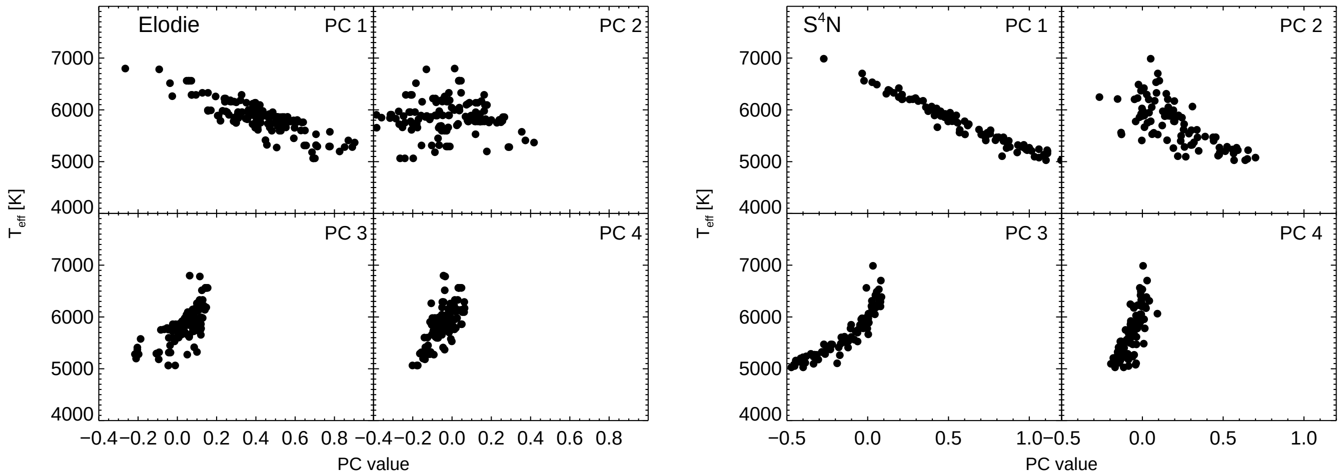

Fig. 5. Plot of the T_{eff} versus the first 4 PCs of every star of Elodie (left panels) and S^4N (right panel).

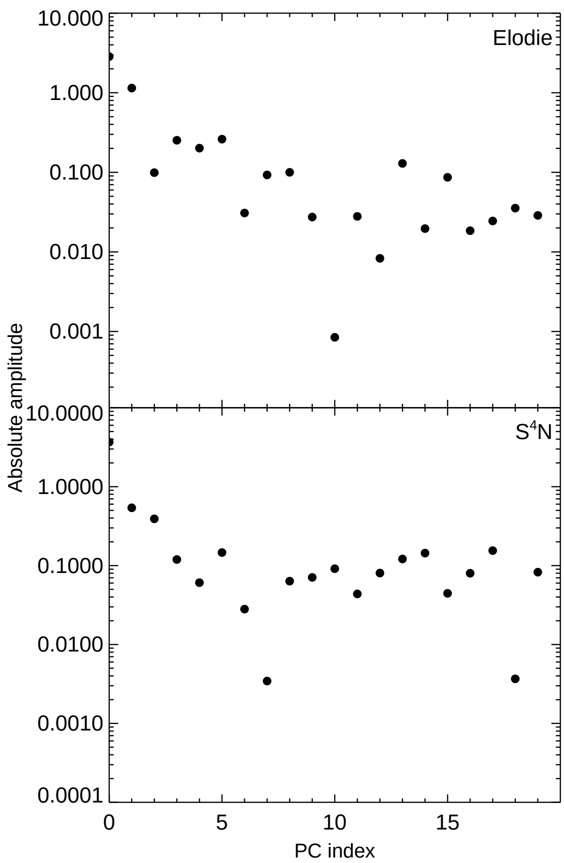

Fig. 4. First 20 principal components of the first star in each library: HD 245 for Elodie (top) and the Sun for S^4N (bottom).

3. Calibration

3.1. General considerations

Our goal is to find a suitable function that, given the principal components of a collection of stars, allows us to compute their effective temperature. Once that function has been established and tested for a calibration set, we can apply it to stars with unknown effective temperatures. There are three potential problems:

1. First, it is important to include stars with spectra of sufficient quality. We verified that a calibration of the effective temperature using the entire Elodie sample (including stars with $Q_{T_{\mathrm{eff}}} < 4$) leads to a poor calibration. We also believe that spectra with different quality flags are subject to different systematic offsets. To solve this issue, we only used stars with $Q_{T_{\mathrm{eff}}} = 4$, ending up with a fairly homogeneous temperature scale.
2. Second, we found difficulties in the simultaneous calibration of stars over a broad range of temperatures. It is obvious that it is of paramount importance to have a sample of stars spanning a sufficiently broad range of physical conditions, since otherwise the results will not be useful. Our calibration considers stars with temperatures between 5000 K and 7000 K and $\log g \geq 3$. In fact, there were only a few stars with temperatures outside this range in the libraries considered. The $\log g$ range was set to avoid giants; given their scarcity in our sample, they would cause a degradation in the calibration. After imposing the selection criteria described above, we ended up with 159 spectra in Elodie and 86 in S^4N.
3. Third, we found the application of standard regression algorithms inadequate. The final calibration procedure has to be general enough to be applied to stars of unknown effective temperature. Given that we include a large number of PCs in the regression, a regular linear regression algorithm based on a maximum-likelihood approach results in overfitting; it not only follows generic properties of the stars as representative examples of their classes, but it also includes peculiarities of individual stars in the calibration sample. To address this issue we employed a Bayesian non-parametric regression algorithm based on a Relevance Vector Machine (RVM; Tipping 2004), which uses Bayesian inference to learn about the data.

3.2. Bayesian calibration

Given that the RVM avoids overfitting, we propose a sufficiently general functional form for the calibration, and let

the data decide on is the optimal level of complexity for our sample. To this end, we write the effective temperature as

$$T_{\rm eff} = T_0 + \sum_{j=1}^{C} a_j \mathrm{PC}_j + \sum_{j=1}^{C} b_j \mathrm{PC}_j^2 + \sum_{j=1}^{C} c_j \mathrm{PC}_j^3 + \sum_{j=1}^{C} d_j \mathrm{PC}_j^4, \tag{5}$$

where PC_j is the j-th principal component of a given star, C is the number of principal components that we consider, and T_0, a_j, b_j, c_j and d_j are coefficients that we have to infer from the calibration data. For the sake of simplicity, we use a compact notation in which the vector $\mathbf{w}$ of length $4C+1$ is built by stacking all the coefficients together

$$\mathbf{w} = (T_0, a_1, a_2, ..., a_C, b_1, ..., d_C). \tag{6}$$

The RVM is based on a Bayesian hierarchical approach to linear regression. The aim is to use the available data to compute the posterior distribution function for the vector of weights $\mathbf{w}$ and the noise variance σ^2 (that can even be estimated from the same data). Therefore, a direct application of the Bayes theorem yields the posterior distribution function for the unknowns

$$p(\mathbf{w}, \sigma^2|\mathbf{d}) = \frac{p(\mathbf{d}|\mathbf{w}, \sigma^2)p(\mathbf{w}, \sigma^2)}{p(\mathbf{d})}, \tag{7}$$

where $\mathbf{d}$ is the data, which contains the principal components and the effective temperature, $p(\mathbf{d}|\mathbf{w}, \sigma^2)$ is the likelihood function that gives an idea of how well the model fits the data, $p(\mathbf{w}, \sigma^2)$ is the prior distribution for the parameters and $p(\mathbf{d})$ is the evidence (e.g., Gregory 2005). The key ingredient invoked by Tipping (2004) is to build a hierarchical prior for $\mathbf{w}$. The prior for $\mathbf{w}$ will depend on a set of hyperparameters $\boldsymbol{\alpha}$, which are learned from the data during the inference process. The final posterior distribution is then, after following the standard procedure in Bayesian statistics of including a prior for the newly defined random variables, given by

$$p(\mathbf{w}, \boldsymbol{\alpha}, \sigma^2|\mathbf{d}) = \frac{p(\mathbf{d}|\mathbf{w}, \sigma^2)p(\mathbf{w}|\boldsymbol{\alpha})p(\boldsymbol{\alpha})p(\sigma^2)}{p(\mathbf{d})}, \tag{8}$$

where we have used the fact that the likelihood does depend directly on $\mathbf{w}$ and not on the particular choice of $\boldsymbol{\alpha}$, and that the priors for $\boldsymbol{\alpha}$ and σ^2 are independent.

The transformation to a hierarchical approach allowed Tipping (2004) to regularize the regression problem by favoring the sparsest solutions, i.e., the solution that contains the least number of non-zero elements in $\mathbf{w}$. This is done by defining the following prior

$$p(\mathbf{w}|\boldsymbol{\alpha}) = \prod_{i=1}^{4C+1} \mathcal{N}(w_i|0, \alpha_i^{-1}), \tag{9}$$

where $\mathcal{N}(w|\mu, \sigma^2)$ is a Gaussian distribution on the variable w with mean μ and variance σ^2. When using an appropriate hyperprior $p(\boldsymbol{\alpha})$ (for instance, a sufficiently broad Gamma distribution), the marginal prior $p(\mathbf{w})$ obtained by integrating out the $\boldsymbol{\alpha}$ parameters strongly favors very small values of $\mathbf{w}$, leading to a very sparse solution. The values of $\boldsymbol{\alpha}$ are estimated from the data using a Type-II maximum likelihood approach (see Tipping 2004, for details).

Applying this scheme, we find the values of the few non-zero elements of the vector $\mathbf{w}$, together with their confidence intervals obtained with a set of calibration stars. Once these parameters are fixed, the next step is to apply the inferred model to a set of test stars and compare the calculated temperatures with the tabulated ones.

Table 1. Internal calibration with stars from Elodie and S^4N

Description	N. PCs	calib. rms (K)	test rms (K)
Elodie internal	2	75	70
	3	64	67
	4	59	55
	5	49	55
	7	44	45
Elodie internal with $Q_{T{\rm eff}} = 3$	3	55	111
	4	49	107
	7	47	97
	9	46	98
S^4N internal	2	85	66
	4	81	62
	5	66	60
	6	63	54
	14	61	53

4. Results

We now discuss the results of applying the previous formalism to the calibration of effective temperature. The coefficients $\mathbf{w}$ are computed using a set of reliable stars for which we have good estimates of the temperature and apply the model to a set of stars of unknown temperatures. We first apply that calibration internally to Elodie and S^4N (calibration and test spectra from the same library), and then externally (calibration and test spectra from different libraries).

It is interesting to point out that, when performing the internal calibration for just one library, we found that the spectral range that we used was not critical for obtaining reliable results. Similar results were obtained for different spectral ranges, unless they were too small. In any case, and in order to avoid further complications, we use the spectral range chosen in Sec. Sect. 2.3.

4.1. Elodie

As noted above, we considered 1245 spectra of 941 different stars that satisfied all the selection criteria described in Sect. 2. Of those stars, only 159 have been flagged as having the highest quality ($Q_{T{\rm eff}} = 4$), temperatures between 5000 K and 7000 K, and values of $\log g \geq 3$.

Our first test is to calibrate with a subset of those spectra (the first 121, ordered by HD number), calculate the temperature of the rest of them (the remaining 38), and compare the calculated temperatures with the ones tabulated in the Elodie database. The results are summarized in Table 1, where we show the rms residual between the predicted temperatures and the original ones in the database as a function of the number of principal components included in the calibration of Eq. 5. This Table presents the rms for the calibration with 159 well as the results from experiments using only spectra with $Q_{T{\rm eff}} = 3$ (since those are the second best spectra in quality) for different number of PCs. One of the key results is that the rms for the test stars (those not used to build the calibration) is very similar to the rms for the calibration stars when only the $Q_{T{\rm eff}} = 4$ stars are considered. This indicates that the regression is not overfitting the calibration data. An additional proof

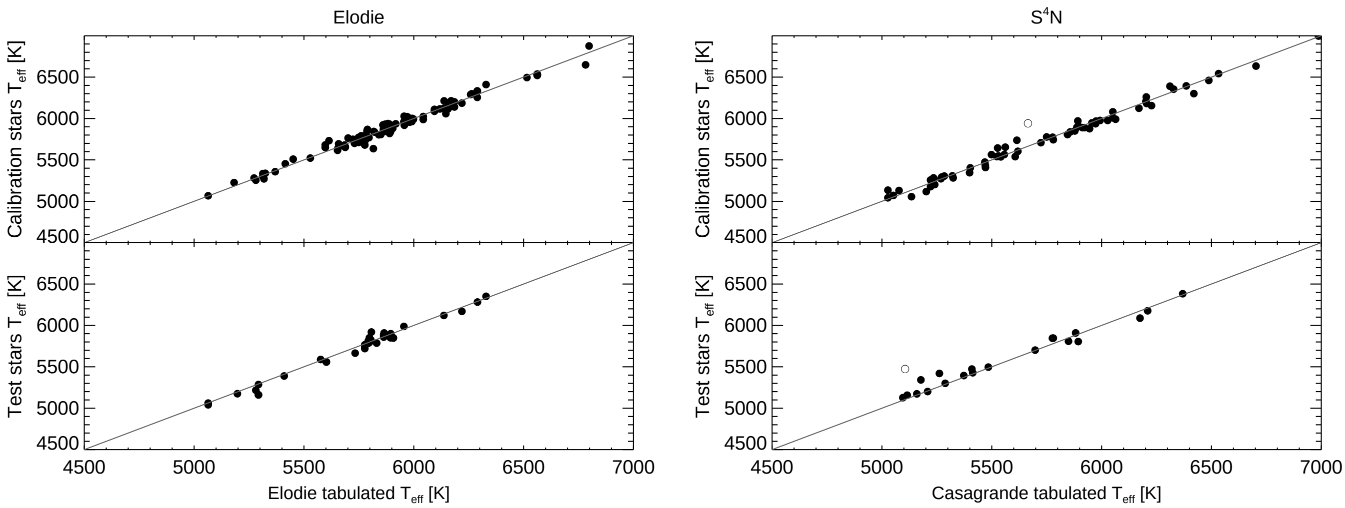

Fig. 6. Calculated temperatures vs tabulated temperatures for the calibration group of stars (upper panel) and the test group of stars (lower panel) of the Elodie sample.

of this is that an accurate calibration is obtained independently from the number of PCs we use. The left-hand panel of Fig. 6 shows the tabulated $T_{\rm eff}$ versus the predicted temperature for the calibration stars (upper panel) and test stars (lower panel).

It is clear from Table 1 that the rms values for the test stars with reduced quality ($Q_{T\rm eff} = 3$) are higher than for the highest-quality stars, while this is not the case for the calibration stars. We interpret this as an indication that our calibration based only on stars with the highest quality temperatures is reliable, while this is not the case when including $Q_{T\rm eff} = 3$ stars. Once we have verified that the method works, we use all the stars with $Q_{T\rm eff} = 4$ as calibrators and infer the temperature of the sample (the complete set of 630 stars that passed all the filters and have tabulated temperatures between 5000 K and 7000 K). By doing so, we infer temperatures of $Q_{T\rm eff} = 4$ quality for all of them. Table 2, includes the calculated temperatures for all the stars.

4.2. S^{4}N

A total of 119 spectra of 119 different stars are available for this catalog. Once we apply the effective temperature and surface gravity filters we are left with 86 stars. Since we assume that all the $T_{\rm eff}$ are equally well determined, we use the first 65 stars as a calibration set and the remaining 21 as a testing sample. As explained in Sect. 2.2, we adopt the $T_{\rm eff}$ values we calculate for these stars using the Casagrande et al. (2010) $b-y$ calibration.

The right panel in Fig. 6 shows the tabulated reference temperatures vs. those we calculate from our method for both the calibration (upper panel) and testing (lower panel) stars. As illustrated in the figure, there are two stars (one in the calibration set and the other in the testing set) for which the predicted temperatures differ sinificantly from the tabulated temperature (marked with an open circle). Those two stars are HR 7578, a spectroscopic binary (Fekel & Beavers 1983), and HD 188512 (Alshain), a variable star that is evolving off the main sequence (Corsaro et al. 2012).

A summary of the results obtained is shown in Tab. 1 (the rms have been calculated without taking into account the two stars mentioned above). The calibration and test rms values are very similar again, which suggests that the model is not overfitting the calibration data and that it is valid for all the spectra in the sample. The slightly larger values of the calibration rms as compared with the test rms is probably due to an small overestimation of the noise in the input data. Nevertheless, this does not strongly affect the calibration.

4.3. External application

We have tested that our method works internally both for Elodie and for S^{4}N independently. Now we check whether we can use one library to calibrate the effective temperatures of the other one and homogenize the scales. We calibrate with Elodie (using just the $Q_{T\rm eff} = 4$ spectra, in the range of 5000-7000 K and $\log g \geq 3$) and infer the temperatures of the stars in S^{4}N.

We have compared the stars that Elodie and S^{4}N have in common (out of 29 mentioned above there are 27 in the correct range of temperature and $\log g$). The mean difference between the Elodie tabulated temperatures and the ones calculated projecting S^{4}N onto Elodie is 88 K, with an rms of just 40 K. In other words, the inferred temperatures are highly correlated with the Elodie ones but with a systematic offset of 88 K.

5. Temperature Scales

We have seen that both Elodie and S^{4}N provide internally coherent temperature scales, and that our method is able to infer the temperature of a star, given its spectrum, with a reasonably small error. We have also seen that when we attempt to apply a PCA calibration based on Elodie spectra to S^{4}N spectra, a systematic offset between the derived temperatures appears. In this section we examine whether the temperature scales used to calibrate our analysis of Elodie spectra, i.e. the Elodie $Q_{T\rm eff} = 4$ literature-based temperatures, and those used for our analysis of the S^{4}N spectra, i.e. the $B-V/b-y$ Casagrande et al. (2010) IRFM-based calibrations, are compatible. We also compare with three additional sources of effective tempera-

tures: the original scale of Alonso et al. (1996) adopted by Allende Prieto et al. (2004) in S[4]N, the spectroscopic temperatures derived by Katz et al. (1998) from Elodie spectra, and the direct determinations by Cayrel et al. (2011).

We selected the set of 29 stars that Elodie and S[4]N have in common, and calculated the mean difference and the rms between the effective temperatures from Alonso et al. (1996) or Casagrande et al. (2010), and those from Elodie. We find that, on average, the Elodie temperatures are higher than those of Alonso et al. (1996) by 70 K (with an rms scatter of 87 K), while they are cooler than those of Casagrande et al. (2010) by 28 K (rms scatter of 85 K) when their $B-V$ calibation is used, or by 50 K (rms scatter of 58 K) when their $b-y$ calibration is adopted. We embraced the Casagrande et al. (2010) $b-y$ calibration for the analysis of S[4]N spectra due to the smaller scatter found in this comparison. Thus, the warmest scale is that by Casagrande et al. (2010), followed by the one based on classical high-resolution spectroscopic analyses, Elodie or Katz et al. (1998), and finally the one proposed by Alonso et al. (1996).

The Elodie $Q_{T\mathrm{eff}} = 4$ or spectroscopic scale (and hence our method, which uses it for calibration), seems to be in good agreement with the recent results of Cayrel et al. (2011). These authors have calculated the effective temperature for 11 stars derived from angular diameters and bolometric fluxes, a technique which is expected to give the most fundamental measurement of the effective temperature. All their 11 stars are in S[4]N, and 7 are also in Elodie. Table 3 displays the Cayrel et al. (2011) direct effective temperatures, the Katz et al. (1998) and Casagrande et al. (2010) temperatures, those adopted in the original S[4]N paper obtained applying the Alonso et al. (1996) calibrations, as well as the temperatures calculated using the internal PCA calibration of Elodie. The Casagrande et al. (2010) $b-y$ temperatures are, on average, 59 K warmer than the Cayrel et al. (2011) direct temperatures, whereas both Casagrande et al. (2010) $B-V$ temperatures and the the Katz et al. (1998) temperatures are consistent with the Cayrel et al. (2011) temperatures, and the Alonso et al. (1996) values are somewhat lower.

Excluding the Sun, which is usually assigned a temperature of 5777 K, there are 6 stars in common for all four sources compared in Fig. 7 and Table 3. The mean (and standard deviation) of the differences between each of the following sources and the direct temperatures of Cayrel et al. (2011) for these stars are: $-17(36)$ K for Katz et al. (1998), $+46(69)$ K for Casagrande et al. (2010) $(b-y)$, $+15(34)$ K for Casagrande et al. (2010) $B-V$, $-42(90)$ K for Alonso et al. (1996), and $+32(54)$ K for our PCA calibration of Elodie spectra, consistent with the discussed systematics.

6. Application to the Elodie archive

We have mainly based our analysis on the Elodie library spectra made public by Prugniel & Soubiran (2001), and Prugniel et al. (2007), but in the 12 years (1994-2006) that this instrument was in operation, many more data were gathered, and these are publicly available from the Elodie archive (Moultaka et al. 2004).

We have downloaded 34,033 spectra from the Elodie archive, selected those in our range of interest (F- and G-type stars), and applied our PCA calibration to infer effective temperatures for them. We keep only 18,696 spectra for which the PCA components are within the range of our calibration, and for which the PCA reconstruction matches the original to better than 5%. The derived T_{eff} values are provided in Table 4, available only in electronic form.

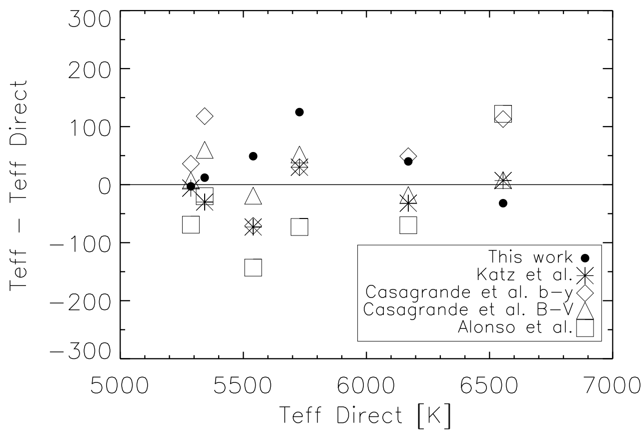

Fig. 7. Differences between different estimates of the effective temperature and the direct values for six stars in common for the sources compared in Table 3.

The 18,696 spectra we provide effective temperatures for correspond to 4,039 unique stars, of which there are 2,553 with just one spectrum. The remainder 1,486 stars have between 2 and 368 spectra, with a median of 4 spectra per star. The derived effective temperatures for the 1,486 stars with multiple spectra show a mean rms scatter of 32 K with a standard deviation of 58 K, and a median rms scatter of 18 K. Clearly the temperatures we provide for different Elodie spectra of the same star are in general highly consistent.

Table 5, only in electronic form, provides a single temperature for each object in the Archive, averaging the results when more than one spectra are available. Note that the archive includes some non-stellar spectra.

Our method is well-suited for application to very large sets of stellar spectra obtained as part of projects such as SEGUE/SDSS (Yanny et al. 2009), APOGEE (Eisenstein et al. 2011), RAVE (Siebert et al. 2011), GALAH (Zucker et al. 2013), Gaia-ESO (Gilmore et al. 2012), or Gaia (Lindegren et al. 2008). This only requires observations with the survey instrumentation of a suitable calibration sample, which may be a difficult enterprise for programs focusing on faint stars, since the best reference stars are quite bright.

7. Conclusions

We have developed a method to obtain effective temperatures from low-resolution spectroscopic data. We project the observed spectra onto the eigenvectors and use a calibration curve derived using a robust non-parametric regression on a set of stars with reliable temperatures.

Unlike the photometric or spectrophotometric methods, this procedure does not suffer from systematic errors associated with interstellar reddening. Also, given a certain T_{eff} scale the method provides coherent T_{eff} values on a homogeneous for all the sample. For instance, within the Elodie library, we carried out the calibration with only 159 spec-

tra with well determined temperatures and obtained the temperatures of other 630 spectra with the same quality (see Table 2). We applied as well the calibration to nearly 19,000 spectra of some 4,000 unique stars from the Elodie archive.

We checked the method internally for both Elodie and S^4N spectra with excellent results. However, when applying the Elodie calibration to S^4N spectra, we discovered that the method was overestimating the S^4N temperatures by about 90 K. We also find that the IRFM-based Casagrande et al. (2010) $B - V$ scale is very close to the Elodie (spectroscopic) scale, but that is not the case for their $b - y$ calibration. We compared those scales with the direct temperatures provided by Cayrel et al. (2011) and found that the Elodie scale and the Casagrande et al. (2010) $B - V$ calibration are in good agreement with them, whereas the Casagrande et al. (2010) $b-y$ calibration presents an offset of about +50 K.

One could use a third spectral library to check whether the method works properly in the spectral range used. We tried introducing the solar spectrum from (Kurucz et al. 1984), smoothed appropriately, and the temperature we obtained was 5789 K, which is in very good agreement with the real temperature, while the method returned a higher temperature for the S^4N solar spectra (in line with the ~ 80 K offset expected from tests with stars in common between Elodie and S^4N).

It would be useful to expand the set of reference (direct) $T_{\rm eff}$ values. We have tried using the temperatures provided by Cayrel et al. (2011) but there was not enough information for a successful PCA mapping; the minimum number of calibration spectra required is about 50 spectra for our $T_{\rm eff}$ range, or approximately one star per 40-K interval.

In addition to the practical application of our Elodie-based calibration of effective temperature, the most interesting outcome of this study is that our experiments demonstrate the potential of PCA to extract information from stellar spectra, and in particular a close connection between the most important principal components and the stellar effective temperatures.

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Table 3. Comparison of $T_{\rm eff}$ in K in different catalogs. The solar values are forced to 5777 K for some sources.

Star	Direct	Elodie Katz et al.	S^4N Casagrande et al. $b-y$	S^4N Casagrande et al. $B-V$	S^4N Alonso et al.	Elodie Our calibration
Sun	5777 ± 5	5777	5777	5777	5777	5750
μ Cas	5343 ± 18	5313	5461	5403	5323	5355
υ And	6170 ± 18	6138	6219	6152	6100	6210
τ Cet	5376 ± 22	-	5451	5377	5328	-
ϵ Eri	5107 ± 21	-	5159	5085	5052	-
α CMi A	6555 ± 17	6562	6668	6563	6677	6523
β Vir	6062 ± 20	-	6176	6112	6076	-
η Boo	6019 ± 18	-	6088	6053	5942	-
ζ Her	5728 ± 24	5758	5758	5780	5655	5853
μ Her	5540 ± 27	5467	5469	5521	5397	5589
σ Dra	5287 ± 21	5281	5323	5294	5218	5284

Table 2. Effective temperatures for stars in the Elodie library.

Filename	Star	$T_{\rm eff}$	$Q_{T{\rm eff}}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00001.fits	HD 245	5433.	3	3.50	1	-0.76	3	5739.
00003.fits	HD 400	6146.	4	4.09	1	-0.28	4	6073.
00004.fits	HD 693	6156.	4	4.13	1	-0.42	3	6123.
00010.fits	HD 3268	6130.	3	4.01	1	-0.24	2	6146.
00012.fits	HD 3567	5991.	4	3.96	1	-1.25	4	5977.
00013.fits	HD 3628	5701.	4	4.06	1	-0.19	2	5768.
00020.fits	HD 4614	5890.	4	4.40	1	-0.28	4	5909.
00028.fits	HD 6582	5313.	4	4.40	1	-0.83	4	5356.
00029.fits	HD 6582	5313.	4	4.40	1	-0.83	4	5334.
00032.fits	HD 6920	5808.	3	3.47	1	-0.11	3	5903.
00034.fits	HD 9562	5821.	4	3.98	1	0.15	4	5855.
00038.fits	HD 10145	5673.	2	4.40	1	-0.01	2	5656.
00039.fits	HD 10307	5862.	4	4.27	1	0.00	4	5871.
00044.fits	HD 12235	6061.	2	4.29	1	0.24	2	6004.
00045.fits	HD 12235	6061.	2	4.29	1	0.24	2	5995.
00048.fits	HD 13612	6097.	1	4.15	1	-0.11	1	6077.
00049.fits	HD 13612	6097.	1	4.15	1	-0.11	1	6077.
00050.fits	HD 13783	5451.	4	4.14	1	-0.67	3	5513.
00051.fits	HD 13974	5597.	4	3.92	1	-0.41	3	5658.
00052.fits	HD 13974	5597.	4	3.92	1	-0.41	3	5684.
00055.fits	HD 14214	5950.	1	4.16	1	0.01	2	6060.
00056.fits	HD 14214	5950.	1	4.16	1	0.01	2	6060.
00057.fits	HD 14214	5950.	1	4.16	1	0.01	2	6054.
00058.fits	HD 14214	6100.	1	4.16	1	0.01	2	6038.
00059.fits	HD 14374	5449.	2	4.30	1	-0.09	2	5448.
00070.fits	HD 16765	6398.	0	4.06	1	-0.14	0	6204.
00071.fits	HD 16765	6400.	0	4.14	1	-0.13	0	6218.
00075.fits	HD 18768	5733.	3	3.81	1	-0.53	3	5812.
00076.fits	HD 18995	6970.	0	4.38	1	-0.05	0	6757.
00077.fits	HD 19019	6063.	2	4.00	1	-0.17	2	6041.
00078.fits	HD 19304	6860.	0	3.88	1	-0.90	0	6282.
00079.fits	HD 19308	5844.	2	4.30	1	0.08	2	5810.
00080.fits	HD 19373	5955.	4	4.12	1	0.04	3	5958.
00081.fits	HD 19445	5963.	3	4.37	1	-2.01	3	5925.
00083.fits	HD 19648	6666.	0	4.31	1	0.00	0	6400.
00084.fits	HD 19994	6094.	4	4.07	1	0.16	4	6098.
00085.fits	HD 19994	6094.	4	4.07	1	0.16	4	6084.
00086.fits	HD 20039	5372.	0	4.36	1	-0.42	0	5298.
00089.fits	HD 20512	5193.	3	3.59	1	-0.20	2	5377.
00091.fits	HD 22211	5763.	0	4.09	1	-0.30	0	6069.
00092.fits	HD 22484	5989.	4	4.10	1	-0.07	4	5961.
00093.fits	HD 22484	5989.	4	4.10	1	-0.07	4	5968.
00095.fits	HD 22556	6155.	1	4.20	1	-0.17	2	5958.
00096.fits	HD 22879	5841.	4	4.27	1	-0.84	4	5802.
00106.fits	HD 24040	5579.	0	4.10	1	0.10	0	5808.
00107.fits	HD 24053	5723.	2	4.40	1	0.04	2	5731.
00110.fits	HD 24552	5803.	0	4.33	1	-0.05	0	5862.
00112.fits	HD 25457	6204.	2	4.30	1	-0.03	2	6183.
00114.fits	HD 25621	6243.	2	3.93	1	0.01	2	6245.
00115.fits	HD 25621	6243.	2	3.93	1	0.01	2	6248.
00116.fits	HD 25621	6243.	2	3.93	1	0.01	2	6228.
00118.fits	HD 26462	6809.	0	4.10	1	0.06	0	6873.
00119.fits	HD 26462	6809.	0	4.10	1	0.06	0	6871.
00124.fits	HD 28005	5900.	2	4.20	1	0.26	2	5757.
00125.fits	HD 12235	6061.	2	4.29	1	0.24	2	5976.
00136.fits	HD 30562	5860.	4	4.03	1	0.17	4	5914.
00137.fits	HD 30562	5860.	4	4.03	1	0.17	4	5907.
00141.fits	HD 33256	6240.	1	3.97	1	-0.33	3	6292.
00142.fits	HD 33256	6240.	1	3.97	1	-0.33	3	6303.
00143.fits	HD 33313	6455.	0	4.27	1	-0.20	0	6168.
00144.fits	HD 33608	6503.	2	4.06	1	0.22	2	6469.
00145.fits	HD 33608	6503.	2	4.06	1	0.22	2	6473.
00170.fits	HD 38769	6942.	0	3.70	1	-2.10	0	6684.
00171.fits	HD 38858	5730.	4	4.30	1	-0.23	2	5691.
00176.fits	HD 39587	5918.	4	4.36	1	-0.03	4	5925.
00177.fits	HD 39833	5767.	1	4.06	1	0.04	2	5819.
00186.fits	HD 40512	6541.	0	4.39	1	0.00	0	6535.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00188.fits	HD 40616	5881.	2	4.00	1	-0.22	2	5716.
00189.fits	HD 40616	5881.	2	4.00	1	-0.22	2	5782.
00197.fits	HD 41661	6200.	1	4.22	1	0.00	0	6472.
00198.fits	HD 41712	6737.	0	4.13	1	0.03	0	6488.
00199.fits	HD 41770	6800.	1	3.77	1	0.52	0	6839.
00202.fits	HD 42548	6400.	1	3.99	1	-0.17	0	6548.
00203.fits	HD 42618	5726.	3	4.58	1	-0.16	2	5721.
00204.fits	HD 43318	6212.	3	4.08	1	-0.18	2	6169.
00205.fits	HD 43318	6212.	3	4.08	1	-0.18	2	6173.
00206.fits	HD 43338	6625.	2	3.71	1	0.04	0	6842.
00207.fits	HD 43358	6300.	1	4.27	1	-0.03	0	6368.
00208.fits	HD 43587	5870.	4	4.10	1	-0.09	2	5880.
00209.fits	HD 43587	5870.	4	4.10	1	-0.09	2	5879.
00210.fits	HD 43587	5870.	4	4.10	1	-0.09	2	5886.
00211.fits	HD 43587	5870.	4	4.10	1	-0.09	2	5921.
00212.fits	HD 43823	6300.	1	3.52	1	0.00	0	6399.
00213.fits	HD 43856	6122.	2	4.10	1	-0.19	2	6112.
00215.fits	HD 44195	6900.	1	3.94	1	0.00	0	7042.
00221.fits	HD 44966	6400.	1	4.26	1	-0.06	0	6327.
00224.fits	HD 45067	5998.	4	4.03	1	-0.09	3	5992.
00225.fits	HD 45067	5998.	4	4.03	1	-0.09	3	5989.
00228.fits	HD 45282	5273.	4	3.15	1	-1.46	4	5279.
00229.fits	HD 45431	6800.	1	3.52	1	0.00	0	6813.
00230.fits	HD 45600	6500.	1	4.33	1	0.00	0	6351.
00233.fits	HD 45759	6200.	1	4.23	1	0.00	0	6081.
00237.fits	HD 46090	5700.	1	4.39	0	0.00	0	5588.
00255.fits	HD 46558	6650.	1	4.09	1	-0.15	0	6774.
00258.fits	HD 47309	5791.	1	4.14	1	0.00	0	5752.
00263.fits	HD 48568	6500.	1	4.28	1	0.00	0	6623.
00281.fits	HD 49932	6100.	1	4.09	1	-0.19	0	6266.
00282.fits	HD 49933	6515.	4	4.27	1	-0.49	3	6483.
00283.fits	HD 50039	6250.	1	4.08	1	0.00	0	6316.
00285.fits	HD 50522	5082.	3	3.12	1	0.05	1	5491.
00286.fits	HD 50554	6026.	3	4.55	1	-0.01	2	6010.
00287.fits	HD 51530	6051.	3	3.94	1	-0.47	3	6041.
00292.fits	HD 57749	6849.	0	4.24	1	-0.01	0	6838.
00293.fits	HD 57749	6849.	0	4.24	1	-0.01	0	6827.
00294.fits	HD 58946	6921.	2	4.07	1	-0.07	0	6936.
00295.fits	HD 59688	5702.	0	4.18	1	-0.07	0	5854.
00298.fits	HD 60803	5895.	0	3.79	0	0.00	0	5887.
00299.fits	HD 60803	5895.	0	3.79	0	0.00	0	5887.
00301.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6522.
00302.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6520.
00303.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6531.
00304.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6530.
00305.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6538.
00306.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6531.
00307.fits	HD 61421	6562.	4	4.08	1	-0.02	4	6530.
00308.fits	HD 62161	6545.	0	4.44	1	0.00	0	6407.
00309.fits	HD 62323	6130.	1	4.40	1	0.00	1	6113.
00313.fits	HD 63108	6714.	0	4.08	1	0.00	0	6595.
00315.fits	HD 64021	6916.	0	4.07	1	-0.06	0	6748.
00317.fits	HD 64090	5415.	4	4.50	1	-1.69	3	5457.
00318.fits	HD 64235	6775.	0	4.05	1	-0.10	0	6611.
00319.fits	HD 64235	6775.	0	4.05	1	-0.10	0	6618.
00320.fits	HD 64606	5182.	4	4.28	1	-0.91	4	5247.
00323.fits	HD 64685	6995.	0	4.36	1	0.00	0	6810.
00324.fits	HD 64815	5864.	2	4.00	1	-0.33	2	5696.
00326.fits	HD 65123	6517.	0	3.90	1	-0.20	0	6202.
00327.fits	HD 65583	5318.	4	4.65	1	-0.70	3	5290.
00329.fits	HD 65874	5936.	2	4.00	1	0.05	2	5925.
00330.fits	HD 66011	6025.	1	3.70	1	0.25	2	6111.
00331.fits	HD 66573	5770.	3	4.48	1	-0.54	3	5642.
00333.fits	HD 67230	6779.	0	3.50	1	0.30	0	7126.
00334.fits	HD 3196	6210.	0	4.14	0	0.00	0	6016.
00335.fits	HD 3196	6234.	0	4.10	1	0.16	0	6016.
00336.fits	HD 68284	5902.	2	4.00	1	-0.56	2	5807.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00337.fits	HD 68380	6668.	0	4.09	1	-0.19	0	6436.
00338.fits	HD 3229	6279.	1	3.90	1	-0.28	1	6308.
00339.fits	HD 3229	6279.	1	3.90	1	-0.28	1	6312.
00341.fits	HD 70923	5986.	2	4.25	1	0.06	2	5996.
00342.fits	HD 70937	7000.	0	4.18	1	-0.20	0	6443.
00343.fits	HD 70937	7000.	0	4.18	1	-0.20	0	6430.
00344.fits	HD 70958	6275.	1	4.21	1	-0.03	0	6192.
00345.fits	HD 70958	6275.	1	4.21	1	-0.03	0	6196.
00346.fits	HD 71148	5801.	3	4.36	1	-0.04	2	5861.
00352.fits	HD 71595	6816.	0	3.99	1	-0.05	0	6481.
00357.fits	HD 72905	5869.	3	4.40	1	-0.08	3	5770.
00358.fits	HD 72945	6276.	2	4.41	1	0.03	2	6241.
00359.fits	HD 72945	6276.	2	4.41	1	0.03	2	5604.
00360.fits	HD 73344	6060.	2	4.10	1	0.08	2	6126.
00362.fits	HD 75318	5450.	1	4.36	1	0.00	0	5397.
00365.fits	HD 76151	5751.	4	4.40	1	0.05	4	5739.
00366.fits	HD 76932	5850.	4	4.05	1	-0.93	4	5824.
00370.fits	HD 78362	6990.	1	4.14	1	0.39	2	7147.
00371.fits	HD 78362	6990.	1	4.14	1	0.39	2	7146.
00373.fits	HD 81809	5688.	4	3.92	1	-0.29	2	5663.
00374.fits	HD 81809	5688.	4	3.92	1	-0.29	2	5650.
00375.fits	HD 81997	6667.	0	4.09	1	0.10	0	6460.
00376.fits	HD 81997	6667.	0	4.09	1	0.10	0	6453.
00378.fits	HD 84607	6888.	0	4.14	1	-0.10	0	6890.
00379.fits	HD 84607	6888.	0	4.12	1	-0.10	0	6884.
00380.fits	HD 84937	6264.	4	3.97	1	-2.15	3	6270.
00385.fits	HD 87141	6351.	3	3.96	1	0.07	3	6255.
00386.fits	HD 87141	6351.	3	3.96	1	0.07	3	6254.
00389.fits	HD 88725	5658.	4	4.34	1	-0.62	4	5701.
00391.fits	HD 89307	5852.	0	4.31	1	-0.16	0	5969.
00392.fits	HD 89507	6719.	0	4.14	1	-0.18	0	6580.
00393.fits	HD 89507	6719.	0	4.14	1	-0.18	0	6585.
00394.fits	HD 89744	6281.	3	4.12	1	0.21	3	6242.
00396.fits	HD 90508	5750.	3	4.35	1	-0.30	2	5774.
00397.fits	HD 94028	5980.	4	4.19	1	-1.45	4	5993.
00400.fits	HD 95128	5865.	4	4.28	1	0.00	4	5848.
00404.fits	HD 98630	6060.	2	4.00	1	0.22	2	6061.
00407.fits	HD 99649	6860.	0	4.25	1	0.00	0	6668.
00409.fits	HD 100563	6409.	2	4.31	1	0.03	2	6449.
00410.fits	HD 100563	6409.	2	4.31	1	0.03	2	6454.
00411.fits	HD 101177	5805.	1	4.35	1	-0.18	2	5917.
00415.fits	HD 103095	5064.	4	4.63	1	-1.33	4	5071.
00418.fits	HD 106116	5725.	1	4.37	0	0.15	2	5677.
00419.fits	HD 106210	5535.	0	4.38	1	0.00	0	5680.
00420.fits	HD 106516	6156.	3	4.36	1	-0.72	3	6120.
00421.fits	HD 106516	6156.	3	4.36	1	-0.72	3	6098.
00423.fits	HD 107705	6040.	2	4.20	1	0.06	2	6161.
00424.fits	HD 108076	5723.	4	4.35	1	-0.84	4	5753.
00426.fits	HD 108678	6827.	0	4.30	1	0.00	0	6506.
00428.fits	HD 108954	6043.	4	4.38	1	-0.12	3	6023.
00429.fits	HD 108956	5855.	0	4.01	1	-0.25	0	5803.
00431.fits	HD 109358	5894.	4	4.39	1	-0.16	4	5832.
00434.fits	HD 110897	5890.	4	4.31	1	-0.50	4	5821.
00445.fits	HD 114762	5880.	4	4.16	1	-0.73	4	5881.
00446.fits	HD 115274	6071.	0	3.91	1	-0.45	0	6134.
00447.fits	HD 115383	5979.	4	4.14	1	0.08	4	5985.
00448.fits	HD 116568	6824.	0	4.39	1	0.00	0	6509.
00449.fits	HD 116568	6824.	0	4.38	1	0.00	0	6505.
00450.fits	HD 117176	5529.	4	3.93	1	-0.07	4	5539.
00451.fits	HD 117635	5214.	2	4.20	1	-0.47	2	5198.
00455.fits	HD 124292	5535.	1	4.36	1	0.00	0	5485.
00458.fits	HD 124850	6096.	1	3.84	1	-0.11	3	6144.
00460.fits	HD 126053	5661.	4	4.37	1	-0.38	4	5678.
00461.fits	HD 126868	5561.	2	3.60	1	-0.04	2	5648.
00463.fits	HD 128167	6782.	4	4.32	1	-0.40	4	6642.
00465.fits	HD 133002	5567.	0	4.21	1	-0.20	0	5530.
00466.fits	HD 133002	5567.	0	4.21	1	-0.20	0	5548.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00468.fits	HD 133826	6075.	0	4.23	1	-0.03	0	6094.
00469.fits	HD 134044	6227.	0	4.41	1	0.00	0	6226.
00471.fits	HD 137107	6037.	2	4.30	1	0.00	2	6061.
00472.fits	HD 137107	6037.	2	4.30	1	0.00	2	6032.
00478.fits	HD 139798	6798.	4	4.16	0	-0.13	2	6849.
00479.fits	HD 140283	5693.	3	3.55	1	-2.49	2	5721.
00480.fits	HD 140283	5693.	3	3.55	1	-2.49	2	5783.
00481.fits	HD 140538	5675.	2	4.50	1	0.02	2	5654.
00482.fits	HD 141004	5890.	4	4.10	1	-0.02	4	5875.
00483.fits	HD 142860	6259.	4	4.09	1	-0.19	4	6297.
00486.fits	HD 144284	6170.	4	4.13	1	0.22	2	6224.
00487.fits	HD 145675	5348.	3	4.44	1	0.43	4	5329.
00489.fits	HD 145729	6030.	0	4.29	1	-0.15	0	6015.
00490.fits	HD 146233	5796.	4	4.40	1	0.02	3	5775.
00495.fits	HD 147907	6912.	0	4.33	1	0.00	0	6621.
00497.fits	HD 150680	5758.	2	3.77	1	0.04	4	5852.
00498.fits	HD 152391	5495.	2	4.30	1	-0.08	2	5434.
00502.fits	HD 154797	6705.	0	4.09	1	0.10	0	6494.
00503.fits	HD 154931	5910.	2	4.00	1	-0.10	2	5863.
00504.fits	HD 157089	5778.	4	4.06	1	-0.55	4	5781.
00506.fits	HD 157214	5685.	4	4.15	1	-0.42	4	5678.
00511.fits	HD 159482	5662.	4	4.18	1	-0.88	4	5699.
00517.fits	HD 161622	6774.	0	4.41	1	0.00	0	6571.
00519.fits	HD 161797A	5467.	2	3.88	1	0.20	4	5590.
00522.fits	HD 162056	6842.	0	4.07	1	-0.09	0	7011.
00526.fits	HD 162691	6842.	0	4.04	1	-0.12	0	6515.
00528.fits	HD 162917	6380.	1	4.10	1	0.10	1	6513.
00535.fits	HD 164115	6938.	0	3.78	1	0.00	0	6628.
00536.fits	HD 164115	6938.	0	3.75	1	0.00	0	6625.
00539.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6711.
00540.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6705.
00541.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6698.
00542.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6696.
00543.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6693.
00544.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6688.
00545.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6695.
00546.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6696.
00547.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6699.
00548.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6701.
00549.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6687.
00552.fits	HD 165146	6892.	0	4.10	1	0.06	0	6608.
00553.fits	HD 165173	5505.	2	4.30	1	-0.05	2	5487.
00555.fits	HD 165401	5816.	4	4.36	1	-0.40	4	5652.
00557.fits	HD 165476	5845.	2	4.10	1	-0.06	2	5821.
00558.fits	HD 165476	5845.	2	4.10	1	-0.06	2	5786.
00562.fits	HD 165908	5957.	4	4.16	1	-0.52	4	5967.
00563.fits	HD 165908	5957.	4	4.16	1	-0.52	4	5922.
00565.fits	HD 166073	6809.	0	4.08	1	0.00	0	6331.
00567.fits	HD 166183	6607.	0	4.04	1	-0.16	0	6295.
00569.fits	HD 166233	6661.	1	3.57	1	0.20	0	6707.
00570.fits	HD 166257	6563.	0	4.16	1	0.08	0	6398.
00572.fits	HD 166285	6257.	2	3.90	1	-0.22	1	6325.
00573.fits	HD 166285	6257.	2	3.90	1	-0.22	1	6324.
00578.fits	HD 167065	6115.	0	4.24	1	-0.02	0	6100.
00579.fits	HD 167278	6350.	1	4.04	1	-0.18	0	6416.
00585.fits	HD 169006	6288.	0	3.98	1	-0.01	0	6094.
00589.fits	HD 170008	5152.	0	3.75	1	-0.10	0	5281.
00593.fits	HD 170291	6300.	1	4.25	1	-0.07	0	6297.
00595.fits	HD 166257	6557.	0	4.13	1	0.04	0	6396.
00596.fits	HD 170579	6400.	1	4.10	1	-0.22	0	6285.
00600.fits	HD 170818	6700.	1	4.14	1	-0.07	0	6784.
00603.fits	HD 170987	6500.	1	4.01	1	-0.22	0	6423.
00608.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6695.
00609.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6696.
00610.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6685.
00611.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6669.
00612.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6677.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00613.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6674.
00614.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6675.
00615.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6666.
00616.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6663.
00617.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6679.
00618.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6662.
00619.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6665.
00620.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6671.
00621.fits	HD 181853	6864.	0	4.31	1	0.00	0	6540.
00622.fits	HD 171836	6800.	1	4.05	1	-0.05	0	6896.
00624.fits	HD 171888	6050.	1	4.20	1	0.00	0	6064.
00628.fits	HD 171954	6600.	1	4.41	1	0.00	0	6646.
00630.fits	HD 172365	5800.	1	4.23	1	0.00	0	6105.
00633.fits	HD 172506	6650.	1	4.38	1	0.00	0	6842.
00635.fits	HD 172675	6150.	1	4.15	1	-0.10	0	6244.
00637.fits	HD 172961	6400.	1	4.01	1	-0.21	0	6426.
00639.fits	HD 173093	6272.	2	4.18	1	-0.24	1	6323.
00645.fits	HD 173667	6329.	4	4.03	1	-0.08	4	6414.
00648.fits	HD 174912	5882.	4	4.35	1	-0.44	4	5940.
00651.fits	HD 175272	6500.	1	4.09	1	0.00	0	6597.
00654.fits	HD 175337	6967.	3	4.19	1	-0.10	0	6952.
00656.fits	HD 175805	6300.	1	4.11	1	0.18	0	6307.
00658.fits	HD 175806	6000.	1	4.14	1	-0.05	0	6159.
00661.fits	HD 176303	6128.	2	4.22	1	-0.07	2	6061.
00664.fits	HD 177552	6800.	1	4.41	1	0.00	0	6789.
00665.fits	HD 177552	6800.	1	4.34	1	0.00	0	6773.
00670.fits	HD 180945	6350.	1	4.15	1	-0.04	0	6319.
00671.fits	HD 181096	6275.	3	4.03	1	-0.28	3	6198.
00672.fits	HD 181214	6578.	0	4.11	1	0.00	0	6335.
00673.fits	HD 181526	6665.	0	4.01	1	-0.23	0	6213.
00674.fits	HD 181853	6864.	0	4.27	1	0.00	0	6534.
00675.fits	HD 181906	6300.	1	4.06	1	-0.16	0	6288.
00678.fits	HD 183085	7000.	1	3.76	1	-1.69	0	6743.
00682.fits	HD 184499	5733.	4	4.04	1	-0.60	4	5752.
00683.fits	HD 184499	5733.	4	4.04	1	-0.60	4	5762.
00684.fits	HD 184571	6676.	0	3.57	1	-0.50	0	6274.
00687.fits	HD 185124	6892.	0	4.08	1	-0.20	0	6668.
00688.fits	HD 185144	5281.	4	4.38	1	-0.26	3	5284.
00690.fits	HD 7476	6480.	2	4.00	1	-0.25	2	6358.
00691.fits	HD 7476	6480.	2	4.00	1	-0.25	2	6346.
00694.fits	HD 186039	6110.	0	4.22	1	-0.16	0	6037.
00695.fits	HD 186104	5752.	3	4.20	1	0.05	2	5763.
00697.fits	HD 186408	5787.	4	4.26	1	0.07	4	5826.
00699.fits	HD 186427	5757.	4	4.35	1	0.06	4	5729.
00700.fits	HD 187003	5767.	0	4.17	1	-0.23	0	5873.
00702.fits	HD 187406	6757.	0	4.31	1	0.00	0	6410.
00703.fits	HD 187691	6137.	4	4.19	1	0.08	4	6117.
00704.fits	HD 187897	5887.	2	4.30	1	0.08	2	5856.
00709.fits	HD 189259	6908.	0	4.08	1	0.00	0	6586.
00711.fits	HD 189340	5852.	2	4.26	1	-0.19	2	5859.
00714.fits	HD 189509	6523.	0	4.09	1	0.10	0	6305.
00715.fits	HD 189509	6523.	0	4.09	1	0.10	0	6306.
00717.fits	HD 189558	5655.	4	3.74	1	-1.14	4	5663.
00718.fits	HD 189712	6834.	0	3.89	1	-0.45	0	6225.
00722.fits	HD 190437	6669.	0	4.14	1	-0.23	0	6274.
00723.fits	HD 190498	6307.	0	4.13	1	0.00	0	6357.
00724.fits	HD 191026	5150.	1	3.49	1	-0.10	1	5317.
00726.fits	HD 191533	6167.	1	3.80	1	-0.10	2	6197.
00727.fits	HD 191548	6842.	0	4.28	1	-0.04	0	6588.
00728.fits	HD 191709	6824.	0	4.20	1	-0.04	0	6563.
00730.fits	HD 192586	6762.	0	4.21	1	-0.03	0	6534.
00734.fits	HD 193374	6788.	0	4.16	1	0.00	0	6456.
00739.fits	HD 194598	5981.	4	4.26	1	-1.15	3	5964.
00740.fits	HD 195005	6075.	2	4.20	1	-0.06	2	6093.
00741.fits	HD 195104	6103.	1	4.30	1	-0.19	2	6134.
00742.fits	HD 194154	6613.	0	4.50	1	0.00	0	6370.
00747.fits	HD 195633	5956.	4	3.84	1	-0.64	3	6044.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00748.fits	HD 195634	6806.	0	3.52	1	0.00	0	6970.
00751.fits	HD 196203	6554.	0	4.10	1	0.14	0	6265.
00755.fits	HD 196755	5598.	3	3.77	1	0.00	3	5724.
00759.fits	HD 197967	6477.	0	4.15	1	0.00	0	6312.
00761.fits	HD 198023	6752.	0	3.99	1	-0.17	0	6546.
00762.fits	HD 198061	6594.	0	4.09	1	0.13	0	6408.
00765.fits	HD 199766	6827.	0	4.28	1	0.00	0	6357.
00766.fits	HD 199766	6827.	0	4.28	1	0.00	0	6363.
00770.fits	HD 200375	6582.	0	4.13	1	0.00	0	6389.
00771.fits	HD 200375	6582.	0	4.15	1	0.00	0	6353.
00773.fits	HD 200580	5818.	4	3.97	1	-0.55	4	5844.
00774.fits	HD 200790	6126.	3	4.09	1	-0.10	3	6113.
00775.fits	HD 200790	6126.	3	4.09	1	-0.10	3	6119.
00780.fits	HD 201099	5867.	3	4.16	1	-0.44	3	5850.
00783.fits	HD 201889	5614.	4	3.99	1	-0.90	3	5736.
00784.fits	HD 201891	5904.	4	4.34	1	-1.04	4	5897.
00786.fits	HD 203235	6071.	2	4.10	1	0.05	2	6165.
00788.fits	HD 203454	6197.	2	4.50	1	-0.16	2	5949.
00789.fits	HD 203522	5858.	0	3.24	1	0.20	0	5930.
00790.fits	HD 204155	5753.	4	4.02	1	-0.69	4	5752.
00792.fits	HD 204613	5680.	3	3.69	1	-0.54	3	5843.
00797.fits	HD 205702	6020.	2	4.20	1	0.01	2	6023.
00802.fits	HD 206862	6639.	0	4.05	1	-0.14	0	6475.
00804.fits	HD 207978	6289.	4	3.99	1	-0.59	4	6263.
00805.fits	HD 207978	6289.	4	3.99	1	-0.59	4	6340.
00806.fits	HD 207978	6289.	4	3.99	1	-0.59	4	6337.
00807.fits	HD 208906	5970.	4	4.26	1	-0.75	4	6031.
00808.fits	HD 209472	6737.	0	4.00	1	-0.16	0	6469.
00812.fits	HD 209965	6114.	0	4.00	1	-0.10	0	5949.
00815.fits	HD 212754	6146.	1	4.50	1	-0.04	1	6142.
00816.fits	HD 212754	6146.	1	4.50	1	-0.04	1	6150.
00818.fits	HD 213235	6760.	0	3.91	1	0.25	0	6837.
00819.fits	HD 214132	6802.	0	4.10	1	-0.10	0	6741.
00822.fits	HD 215648	6222.	1	4.07	1	-0.30	4	6118.
00828.fits	HD 216385	6219.	4	3.95	1	-0.26	3	6205.
00829.fits	HD 217014	5761.	4	4.28	1	0.15	4	5778.
00832.fits	HD 217927	6707.	0	4.14	1	0.00	0	6515.
00833.fits	HD 218059	6253.	1	4.27	1	-0.27	2	6259.
00834.fits	HD 218209	5592.	2	4.25	1	-0.51	2	5576.
00840.fits	HD 219617	5889.	4	3.92	1	-1.40	3	5937.
00841.fits	HD 219617	5889.	4	3.92	1	-1.40	3	5920.
00842.fits	HD 219623	6099.	4	4.15	1	0.00	4	6105.
00843.fits	HD 219877	6908.	0	4.22	1	0.00	0	6677.
00844.fits	HD 219877	6908.	0	4.31	1	0.00	0	6678.
00849.fits	HD 221377	6208.	2	3.63	1	-0.83	3	6321.
00852.fits	HD 221950	6311.	1	4.03	1	-0.90	0	6219.
00853.fits	HD 221950	6311.	1	3.57	1	-0.90	0	6219.
00855.fits	HD 222368	6160.	4	4.14	1	-0.21	4	6159.
00856.fits	HD 222368	6160.	4	4.14	1	-0.21	4	6169.
00857.fits	HD 222368	6160.	4	4.14	1	-0.21	4	6173.
00865.fits	HD 224617	6576.	1	3.70	1	-0.27	1	6511.
00866.fits	HD 224617	6576.	1	3.70	1	-0.27	1	6508.
00868.fits	HD 224930	5348.	3	4.27	1	-0.84	3	5410.
00872.fits	HD 338529	6207.	3	3.86	1	-2.25	3	6219.
00873.fits	HD 345957	5749.	4	3.79	1	-1.43	3	5724.
00876.fits	BD+044551	5789.	4	3.81	1	-1.54	3	5882.
00877.fits	BD+174708	5993.	4	3.94	1	-1.65	3	6004.
00879.fits	HD 345957	5749.	4	3.79	1	-1.43	3	5782.
00880.fits	BD+251981	6786.	2	4.25	1	-1.16	1	6729.
00881.fits	BD+290366	5668.	3	4.32	1	-0.96	4	5688.
00882.fits	BD+292290	5570.	0	4.38	1	0.00	0	5640.
00885.fits	BD+413931	5411.	3	4.62	1	-1.73	3	5436.
00889.fits	BD+660268	5324.	4	4.57	1	-2.10	3	5307.
00890.fits	BD+720094	6084.	1	4.47	1	-1.64	3	6058.
00895.fits	HD 89269	5674.	2	4.40	1	-0.23	2	5627.
00897.fits	HD 108954	6043.	4	4.38	1	-0.12	3	5973.
00903.fits	SUN	5777.	4	4.44	1	0.00	4	5764.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T{\rm eff}}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
00904.fits	SUN	5777.	4	4.44	1	0.00	4	5689.
00905.fits	SUN	5777.	4	4.44	1	0.00	4	5744.
00906.fits	SUN	5777.	4	4.44	1	0.00	4	5744.
00907.fits	SUN	5777.	4	4.44	1	0.00	4	5783.
00908.fits	SUN	5777.	4	4.44	1	0.00	4	5771.
00909.fits	SUN	5777.	4	4.44	1	0.00	4	5769.
00912.fits	BD+203603	6201.	2	4.22	1	-2.07	3	6129.
00913.fits	BD+292091	5780.	4	4.46	1	-1.80	1	5746.
00915.fits	BD+362165	6222.	3	4.43	1	-1.33	2	6091.
00917.fits	BD+423607	5893.	3	4.31	1	-2.03	3	5800.
00927.fits	HD 245	5433.	3	3.50	1	-0.76	3	5731.
00928.fits	HD 432	6810.	1	4.09	1	-0.10	0	6788.
00930.fits	HD 842	6707.	0	3.52	1	0.00	0	7090.
00935.fits	HD 1562	5828.	2	4.00	1	-0.32	2	5770.
00947.fits	HD 4614	5890.	4	4.40	1	-0.28	4	5863.
00950.fits	HD 4813	6185.	4	4.45	1	-0.15	4	6188.
00951.fits	HD 4813	6185.	4	4.45	1	-0.15	4	6157.
00952.fits	HD 5015	6119.	4	4.09	1	0.01	4	6115.
00954.fits	HD 5294	5779.	2	4.10	1	-0.17	2	5729.
00955.fits	HD 5294	5779.	2	4.10	1	-0.17	2	5703.
00966.fits	HD 6715	5652.	1	4.40	1	-0.20	0	5595.
00972.fits	HD 8574	6069.	3	4.36	1	0.01	2	6056.
00975.fits	HD 9472	5700.	1	4.50	1	-0.03	0	5694.
00976.fits	HD 9826	6138.	4	4.13	1	0.08	4	6209.
00977.fits	HD 9919	6798.	1	4.05	1	-0.47	1	6724.
00979.fits	HD 10086	5700.	1	4.40	1	0.09	1	5685.
00980.fits	HD 10086	5700.	1	4.40	1	0.09	1	5693.
00981.fits	HD 10307	5862.	4	4.27	1	0.00	4	5854.
00983.fits	HD 10780	5369.	4	4.31	1	0.05	3	5393.
00984.fits	HD 11007	5975.	4	4.10	1	-0.22	3	5966.
00987.fits	HD 11926	5669.	0	4.50	1	0.00	0	5680.
00991.fits	HD 12846	5628.	0	4.27	1	-0.19	0	5705.
00993.fits	HD 13174	6430.	1	3.75	1	-1.90	0	6831.
00996.fits	HD 13403	5653.	4	4.00	1	-0.31	2	5632.
00997.fits	HD 13507	5714.	2	4.50	1	-0.02	2	5671.
00998.fits	HD 13555	6332.	3	3.98	1	-0.28	3	6320.
00999.fits	HD 13825	5705.	1	4.39	1	0.10	0	5721.
01000.fits	HD 13974	5597.	4	3.92	1	-0.41	3	5668.
01002.fits	HD 14221	6342.	1	3.99	1	-0.40	1	6358.
01006.fits	HD 15335	5893.	3	3.89	1	-0.19	2	5847.
01010.fits	HD 15753	5489.	0	4.21	1	-0.20	0	5588.
01011.fits	HD 15830	5540.	0	4.42	1	0.00	0	5668.
01012.fits	HD 15866	5662.	0	4.10	1	0.12	0	5889.
01013.fits	HD 16232	6462.	1	4.50	1	0.27	1	6237.
01019.fits	HD 17674	5893.	4	4.00	1	-0.14	2	5863.
01020.fits	HD 17905	6479.	1	4.19	1	0.00	0	6429.
01021.fits	HD 18144	5500.	1	4.30	1	0.03	1	5578.
01024.fits	HD 18803	5658.	2	4.39	1	0.14	2	5708.
01025.fits	HD 20630	5704.	3	4.46	1	0.05	3	5680.
01032.fits	HD 23050	5929.	2	4.40	1	-0.36	2	5837.
01033.fits	HD 23050	5929.	2	4.40	1	-0.36	2	5805.
01056.fits	HD 24040	5586.	0	4.25	1	0.15	0	5851.
01057.fits	HD 24206	5633.	2	4.50	1	-0.08	2	5632.
01058.fits	HD 24496	5322.	0	4.40	1	-0.10	0	5562.
01063.fits	HD 26913	5596.	2	4.56	1	-0.13	2	5651.
01064.fits	HD 26923	5954.	3	4.49	1	0.08	2	5978.
01067.fits	HD 27685	5666.	0	4.48	1	0.08	0	5734.
01068.fits	HD 28447	5639.	2	4.00	1	-0.09	2	5597.
01069.fits	HD 29150	5733.	2	4.30	1	0.00	2	5728.
01070.fits	HD 29645	5993.	3	4.02	1	0.08	3	6039.
01072.fits	HD 32259	5832.	0	4.29	1	-0.11	0	5880.
01073.fits	HD 33021	5792.	0	4.06	1	-0.21	0	5757.
01074.fits	HD 33632	6017.	2	4.30	1	-0.23	2	6127.
01079.fits	HD 35961	5834.	0	4.17	1	-0.17	0	5862.
01080.fits	HD 36066	5891.	2	3.98	1	-0.03	2	6012.
01081.fits	HD 36215	5921.	0	4.04	1	0.10	0	6023.
01082.fits	HD 36667	5776.	1	4.00	1	-0.45	2	5876.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T{\rm eff}}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
01083.fits	HD 37124	5602.	4	4.53	1	-0.40	4	5578.
01084.fits	HD 37124	5602.	4	4.53	1	-0.40	4	5580.
01085.fits	HD 38230	5063.	0	4.52	1	-0.10	0	5295.
01093.fits	HD 40616	5881.	2	4.00	1	-0.22	2	5831.
01094.fits	HD 40650	5981.	0	4.25	1	-0.18	0	6025.
01096.fits	HD 41330	5901.	3	4.21	1	-0.22	3	5877.
01103.fits	HD 41547	6995.	0	3.57	1	-0.10	0	6864.
01104.fits	HD 41547	6995.	0	4.02	1	-0.17	0	6864.
01105.fits	HD 41593	5309.	3	4.42	1	0.02	3	5304.
01106.fits	HD 41593	5309.	3	4.42	1	0.02	3	5358.
01108.fits	HD 41770	6800.	1	3.85	1	0.36	0	6822.
01116.fits	HD 42278	6995.	0	4.24	1	-0.20	0	6669.
01117.fits	HD 42278	6995.	0	4.24	1	-0.20	0	6673.
01123.fits	HD 42548	6400.	1	3.99	1	-0.17	0	6554.
01125.fits	HD 42618	5726.	3	4.58	1	-0.16	2	5725.
01129.fits	HD 42807	5737.	1	4.39	1	0.00	0	5628.
01130.fits	HD 42807	5737.	1	4.39	1	0.00	0	5672.
01140.fits	HD 43318	6212.	3	4.08	1	-0.18	2	6184.
01141.fits	HD 43338	6625.	2	3.71	1	0.04	0	6850.
01143.fits	HD 43338	6625.	2	3.71	1	0.04	0	6837.
01144.fits	HD 43523	5994.	0	4.28	1	0.00	0	6131.
01148.fits	HD 43856	6122.	2	4.10	1	-0.19	2	6092.
01149.fits	HD 43947	5955.	4	4.34	1	-0.28	3	5974.
01151.fits	HD 44195	6900.	1	3.96	1	0.03	0	7026.
01157.fits	HD 44614	5816.	0	4.17	1	0.00	0	6012.
01167.fits	HD 45391	5707.	1	4.46	1	-0.37	2	5692.
01172.fits	HD 46122	5100.	1	3.09	1	-0.25	0	5343.
01174.fits	HD 46301	6200.	1	4.36	1	0.00	0	6343.
01187.fits	HD 47309	5791.	1	4.40	1	0.00	0	5779.
01188.fits	HD 47309	5791.	1	4.14	1	0.00	0	5830.
01190.fits	HD 48616	6100.	1	3.61	1	0.40	0	6029.
01209.fits	HD 50554	6026.	3	4.55	1	-0.01	2	6000.
01212.fits	HD 50794	7000.	0	4.40	1	-0.07	0	6857.
01216.fits	HD 51219	5750.	1	4.40	1	0.04	0	5642.
01218.fits	HD 51419	5746.	2	4.10	1	-0.37	2	5718.
01219.fits	HD 51419	5746.	2	4.10	1	-0.37	2	5662.
01226.fits	HD 54371	5500.	1	4.40	1	0.00	0	5588.
01233.fits	HD 55575	5895.	4	4.34	1	-0.31	3	5890.
01237.fits	HD 55973	6850.	1	4.14	1	-0.10	0	6999.
01240.fits	HD 56303	5750.	1	4.17	1	0.00	0	5969.
01241.fits	HD 56394	6820.	0	4.11	1	-0.11	0	6444.
01245.fits	HD 56515	6000.	1	4.19	1	0.00	0	6015.
01249.fits	HD 57006	6000.	1	4.16	1	0.00	0	6141.
01250.fits	HD 57006	6000.	1	3.93	1	-0.10	0	6159.
01251.fits	HD 57006	6000.	1	4.16	1	-0.03	0	6133.
01262.fits	HD 58431	6900.	1	4.33	1	-0.07	0	7031.
01266.fits	HD 58595	5707.	2	4.30	1	-0.31	2	5536.
01269.fits	HD 58923	7000.	1	3.90	1	0.10	0	7225.
01274.fits	HD 59380	6280.	1	4.27	1	-0.17	2	6304.
01275.fits	HD 59380	6280.	1	4.27	1	-0.17	2	6303.
01278.fits	HD 59984	5907.	4	4.02	1	-0.80	3	5847.
01279.fits	HD 59984	5907.	4	4.02	1	-0.80	3	5848.
01285.fits	HD 62346	5533.	0	4.05	1	-0.30	0	5635.
01287.fits	HD 62613	5541.	2	4.40	1	-0.10	2	5532.
01288.fits	HD 63433	5700.	1	4.49	1	-0.04	0	5626.
01289.fits	HD 63436	6970.	0	4.14	1	-0.10	0	7023.
01293.fits	HD 66011	6025.	1	3.70	1	0.25	2	6114.
01296.fits	HD 67589	6921.	0	4.32	1	-0.02	0	6561.
01298.fits	HD 68017	5605.	3	4.20	1	-0.42	2	5573.
01299.fits	HD 68638	5430.	2	4.40	1	-0.24	2	5396.
01300.fits	HD 68638	5430.	2	4.40	1	-0.24	2	5447.
01302.fits	HD 70110	5913.	2	3.97	1	0.07	2	5940.
01303.fits	HD 70110	5913.	2	3.97	1	0.07	2	5959.
01304.fits	HD 70298	6816.	0	4.02	1	-0.30	0	6302.
01308.fits	HD 71148	5801.	3	4.36	1	-0.04	2	5832.
01312.fits	HD 71640	6285.	0	4.19	1	-0.07	0	6088.
01313.fits	HD 71881	5840.	0	4.17	1	0.00	0	5894.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
01318.fits	HD 73226	5800.	1	4.25	1	0.03	0	5881.
01320.fits	HD 73344	6060.	2	4.10	1	0.08	2	6125.
01321.fits	HD 73344	6060.	2	4.10	1	0.08	2	6158.
01323.fits	HD 73668	5886.	0	4.27	1	0.00	0	5967.
01324.fits	HD 73668	5886.	0	4.27	1	0.00	0	5969.
01325.fits	HD 74011	5764.	2	4.15	1	-0.60	2	5784.
01326.fits	HD 74156	6078.	2	4.38	1	0.12	2	6044.
01327.fits	HD 74156	6078.	2	4.38	1	0.12	2	6045.
01332.fits	HD 75933	5846.	0	4.10	1	-0.16	0	5825.
01334.fits	HD 76752	5659.	0	4.24	1	0.03	0	5790.
01335.fits	HD 76780	5815.	2	4.80	1	0.21	2	5814.
01337.fits	HD 78175	6722.	0	4.07	1	-0.02	0	6448.
01342.fits	HD 80536	5738.	0	4.18	1	0.00	0	5927.
01345.fits	HD 149419	6673.	0	4.07	1	-0.35	0	6556.
01349.fits	HD 82885	5663.	2	4.56	1	0.32	2	5576.
01354.fits	HD 86133	5905.	0	4.30	1	-0.21	0	5931.
01356.fits	HD 86560	5846.	1	4.21	1	-0.41	2	5904.
01362.fits	HD 89251	5886.	2	4.00	1	-0.12	2	5826.
01363.fits	HD 89307	5850.	0	4.28	1	-0.17	0	5939.
01364.fits	HD 89307	5846.	0	4.21	1	-0.20	0	5940.
01365.fits	HD 89389	6031.	1	4.20	1	0.00	0	6059.
01366.fits	HD 89744	6281.	3	4.12	1	0.21	3	6222.
01369.fits	HD 91347	5912.	3	4.32	1	-0.45	3	5883.
01370.fits	HD 91347	5912.	3	4.32	1	-0.45	3	5865.
01372.fits	HD 92127	6550.	0	4.12	1	-0.22	0	6354.
01374.fits	HD 95128	5865.	4	4.28	1	0.00	4	5889.
01375.fits	HD 95128	5865.	4	4.28	1	0.00	4	5902.
01376.fits	HD 96094	5908.	2	3.97	1	-0.33	2	5907.
01378.fits	HD 96094	5908.	2	3.97	1	-0.33	2	5871.
01379.fits	HD 97711	5605.	0	4.08	1	0.00	0	5778.
01380.fits	HD 97711	5605.	0	4.00	1	0.00	0	5772.
01382.fits	HD 97916	6354.	3	4.10	1	-1.00	3	6389.
01383.fits	HD 98630	6060.	2	4.00	1	0.22	2	6019.
01384.fits	HD 99491	5456.	3	4.34	1	0.24	3	5480.
01386.fits	HD 99505	5673.	0	4.25	1	-0.14	0	5757.
01388.fits	HD 101177	5805.	1	4.35	1	-0.18	2	5877.
01389.fits	HD 101242	5790.	1	4.68	1	0.07	2	5788.
01391.fits	HD 101690	5835.	0	4.24	1	-0.18	0	5922.
01392.fits	HD 103095	5064.	4	4.63	1	-1.33	4	5066.
01393.fits	HD 103095	5064.	4	4.63	1	-1.33	4	5069.
01397.fits	HD 106252	5895.	2	4.40	1	-0.05	2	5883.
01399.fits	HD 107213	6290.	4	4.10	1	0.16	3	6278.
01400.fits	HD 107700	6748.	0	3.24	1	0.20	0	6229.
01401.fits	HD 107700	6748.	0	3.24	1	0.20	0	6229.
01402.fits	HD 107700	6748.	0	3.24	1	0.20	0	6239.
01403.fits	HD 107700	6748.	0	3.24	1	0.20	0	6231.
01404.fits	HD 107700	6748.	0	3.24	1	0.20	0	6227.
01405.fits	HD 108134	5755.	1	4.22	1	-0.38	2	5901.
01406.fits	HD 108956	5852.	0	4.07	1	-0.27	0	5794.
01407.fits	HD 109358	5894.	4	4.39	1	-0.16	4	5855.
01411.fits	HD 111812	5689.	3	4.32	1	0.00	0	5779.
01431.fits	HD 112735	5898.	0	4.02	1	0.00	0	6084.
01432.fits	HD 112758	5197.	4	4.40	1	-0.44	3	5203.
01433.fits	HD 113319	5623.	0	4.18	1	-0.08	0	5748.
01439.fits	HD 116442	5200.	1	4.30	1	-0.40	0	5258.
01447.fits	HD 119550	5610.	0	4.13	1	0.00	0	5816.
01448.fits	HD 120066	5751.	0	4.17	1	0.00	0	5886.
01450.fits	HD 120136	6479.	3	4.31	1	0.27	4	6420.
01455.fits	HD 125184	5634.	3	4.09	1	0.25	4	5666.
01456.fits	HD 126031	6956.	0	3.72	1	-0.09	0	6964.
01457.fits	HD 126246	5934.	0	4.22	1	-0.04	0	5992.
01459.fits	HD 126323	5901.	0	4.19	1	0.00	0	6036.
01460.fits	HD 126512	5774.	2	4.05	1	-0.58	2	5776.
01461.fits	HD 126512	5774.	2	4.05	1	-0.58	2	5812.
01462.fits	HD 126512	5774.	2	4.05	1	-0.58	2	5751.
01466.fits	HD 129499	5883.	0	4.19	1	0.00	0	6011.
01467.fits	HD 129814	5769.	0	4.23	1	-0.07	0	5845.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T{\rm eff}}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
01468.fits	HD 130322	5410.	4	4.51	1	0.06	4	5418.
01470.fits	HD 131042	5650.	0	4.28	1	-0.10	0	5744.
01473.fits	HD 133002	5567.	0	4.21	1	-0.20	0	5541.
01476.fits	HD 134169	5831.	4	3.95	1	-0.84	3	5807.
01477.fits	HD 135101	5625.	2	4.22	1	0.08	2	5718.
01478.fits	HD 135101	5625.	2	4.22	1	0.08	2	5599.
01479.fits	HD 135101	5625.	2	4.22	1	0.08	2	5596.
01480.fits	HD 135204	5434.	3	4.00	1	-0.11	2	5398.
01481.fits	HD 135599	5257.	2	4.35	1	-0.12	2	5259.
01482.fits	HD 136202	6076.	3	3.90	1	-0.11	3	6137.
01488.fits	HD 136923	5379.	1	4.58	1	-0.07	1	5361.
01490.fits	HD 136923	5379.	1	4.58	1	-0.07	1	5354.
01491.fits	HD 137107	6037.	2	4.30	1	0.00	2	6045.
01508.fits	HD 139324	5790.	0	4.18	1	0.00	0	5894.
01513.fits	HD 140233	5854.	0	4.00	1	-0.16	0	5900.
01514.fits	HD 141272	5155.	0	4.35	1	-0.02	0	5330.
01519.fits	HD 142373	5806.	2	4.08	1	-0.43	4	5786.
01524.fits	HD 144287	5414.	2	4.50	1	-0.15	2	5400.
01526.fits	HD 144579	5293.	4	4.10	1	-0.70	2	5227.
01527.fits	HD 144579	5293.	4	4.10	1	-0.70	2	5221.
01528.fits	HD 144579	5293.	4	4.10	1	-0.70	2	5300.
01536.fits	HD 150680	5758.	2	3.77	1	0.04	4	5845.
01544.fits	HD 154345	5504.	3	4.44	1	-0.12	2	5505.
01553.fits	HD 158633	5290.	2	4.20	1	-0.49	2	5246.
01555.fits	HD 159062	5414.	2	4.30	1	-0.40	2	5351.
01556.fits	HD 159062	5414.	2	4.30	1	-0.40	2	5361.
01557.fits	HD 159222	5807.	4	4.29	1	0.08	2	5896.
01558.fits	HD 159307	6261.	2	4.00	1	-0.69	2	6112.
01571.fits	HD 161750	6900.	0	4.16	1	0.00	0	6780.
01572.fits	HD 161797A	5467.	2	3.88	1	0.20	4	5587.
01580.fits	HD 162691	6842.	0	4.04	1	-0.13	0	6515.
01585.fits	HD 163611	6400.	1	3.29	1	-0.30	0	6116.
01586.fits	HD 163611	6400.	1	3.00	1	-0.30	0	6189.
01587.fits	HD 163611	6400.	1	3.00	1	-0.30	0	6186.
01593.fits	HD 164115	6938.	0	3.74	1	0.00	0	6610.
01594.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6682.
01595.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6694.
01596.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6690.
01597.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6697.
01598.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6691.
01599.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6689.
01600.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6678.
01601.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6693.
01602.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6693.
01603.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6698.
01604.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6691.
01605.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6691.
01606.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6690.
01607.fits	HD 164259	6732.	1	4.14	1	-0.12	1	6690.
01611.fits	HD 164651	5382.	0	4.40	1	-0.01	0	5573.
01612.fits	HD 164922	5392.	2	4.30	1	0.04	2	5452.
01613.fits	HD 165146	6892.	0	4.10	1	0.06	0	6597.
01614.fits	HD 165173	5505.	2	4.30	1	-0.05	2	5490.
01617.fits	HD 165341	5105.	2	4.61	1	-0.17	3	5346.
01618.fits	HD 165341	5105.	2	4.61	1	-0.17	3	5347.
01619.fits	HD 165341	5105.	2	4.61	1	-0.17	3	5348.
01620.fits	HD 165672	5779.	0	4.33	1	0.05	0	5877.
01633.fits	HD 168009	5793.	4	4.14	1	-0.04	3	5815.
01634.fits	HD 168009	5793.	4	4.14	1	-0.04	3	5786.
01645.fits	HD 169986	6100.	1	3.24	1	0.20	0	6171.
01649.fits	HD 170291	6300.	1	4.32	1	-0.06	0	6269.
01656.fits	HD 171067	5674.	1	4.42	1	0.00	0	5664.
01660.fits	HD 171304	5900.	1	4.21	1	0.00	0	5926.
01662.fits	HD 171802	6554.	2	4.20	1	0.10	1	6621.
01663.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6685.
01664.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6683.
01665.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6666.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
01666.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6684.
01667.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6687.
01668.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6678.
01669.fits	HD 171834	6700.	2	4.10	1	-0.30	1	6669.
01684.fits	HD 172588	6800.	1	3.52	1	0.00	0	7007.
01685.fits	HD 172588	6800.	1	3.52	1	0.00	0	6983.
01686.fits	HD 172675	6150.	1	4.10	1	-0.10	0	6243.
01691.fits	HD 173216	6150.	1	4.03	1	0.00	0	6219.
01696.fits	HD 173634	6300.	1	4.24	1	-0.07	0	6433.
01697.fits	HD 173667	6329.	4	4.03	1	-0.08	4	6364.
01699.fits	HD 173701	5423.	2	4.40	1	0.18	2	5342.
01707.fits	HD 174704	6702.	2	3.50	1	0.39	1	6865.
01719.fits	HD 175225	5230.	1	3.55	1	-0.01	1	5433.
01721.fits	HD 175272	6500.	1	4.10	1	0.00	0	6634.
01722.fits	HD 175337	6967.	3	4.29	1	-0.04	0	6975.
01723.fits	HD 175337	6967.	3	4.36	1	-0.07	0	6974.
01724.fits	HD 175337	6967.	3	4.36	1	-0.07	0	6971.
01730.fits	HD 175726	6000.	1	4.23	1	-0.03	0	5912.
01733.fits	HD 169985	5780.	1	3.24	1	0.27	1	6169.
01734.fits	HD 175900	5814.	0	4.03	1	-0.23	0	5943.
01735.fits	HD 176112	7000.	1	3.73	1	-1.74	0	7327.
01736.fits	HD 176112	7000.	1	3.62	1	-2.24	0	7285.
01737.fits	HD 176118	6500.	1	4.12	1	0.00	0	6548.
01742.fits	HD 176841	5841.	2	4.30	1	0.23	2	5858.
01743.fits	HD 176841	5841.	2	4.30	1	0.23	2	5879.
01744.fits	HD 176851	6500.	1	3.95	1	-0.69	0	6649.
01751.fits	HD 177749	6400.	1	4.15	1	-0.03	0	6377.
01753.fits	HD 177904	6600.	1	4.17	1	-0.12	0	6748.
01754.fits	HD 177904	6600.	1	4.30	1	-0.13	0	6595.
01760.fits	HD 178574	6400.	1	4.35	1	0.00	0	6444.
01761.fits	HD 178596	6718.	2	4.13	1	0.03	1	6797.
01769.fits	HD 180086	6800.	1	3.75	1	-1.70	0	6865.
01774.fits	HD 180973	7000.	1	3.85	1	-0.12	0	6600.
01775.fits	HD 181096	6275.	3	4.03	1	-0.28	3	6201.
01778.fits	HD 181420	6300.	1	4.00	1	-0.10	0	6453.
01782.fits	HD 181655	5676.	1	4.41	1	0.00	0	5716.
01783.fits	HD 181806	6350.	1	4.20	1	-0.09	0	6343.
01785.fits	HD 182640	6790.	2	4.11	1	-0.13	0	6934.
01786.fits	HD 182640	6790.	2	4.11	1	-0.12	0	6925.
01787.fits	HD 182640	6790.	2	4.11	1	-0.13	0	6924.
01788.fits	HD 182640	6790.	2	4.11	1	-0.12	0	6931.
01789.fits	HD 182736	5430.	1	3.70	1	-0.06	2	5355.
01791.fits	HD 183341	5911.	2	4.30	1	-0.01	2	5893.
01792.fits	HD 183341	5911.	2	4.30	1	-0.01	2	5900.
01795.fits	HD 184499	5733.	4	4.04	1	-0.60	4	5687.
01796.fits	HD 184663	6478.	2	4.22	1	0.03	1	6590.
01797.fits	HD 184663	6478.	2	4.22	1	0.03	1	6595.
01798.fits	HD 184663	6478.	2	4.22	1	0.03	1	6571.
01800.fits	HD 185144	5281.	4	4.38	1	-0.26	3	5265.
01802.fits	HD 186379	5863.	4	3.91	1	-0.37	4	5868.
01803.fits	HD 186379	5863.	4	3.91	1	-0.37	4	5877.
01805.fits	HD 187123	5804.	4	4.38	1	0.12	4	5823.
01806.fits	HD 187691	6137.	4	4.19	1	0.08	4	6115.
01807.fits	HD 187923	5700.	3	3.99	1	-0.14	3	5737.
01811.fits	HD 188326	5251.	0	3.70	1	0.00	0	5425.
01812.fits	HD 188326	5251.	0	3.70	1	0.00	0	5441.
01814.fits	HD 189087	5341.	2	4.40	1	-0.12	2	5337.
01817.fits	HD 190067	5387.	1	4.20	1	-0.40	0	5410.
01818.fits	HD 190228	5294.	3	3.85	1	-0.27	3	5337.
01819.fits	HD 190228	5294.	3	3.85	1	-0.27	3	5370.
01822.fits	HD 190360	5576.	4	4.36	1	0.21	3	5572.
01833.fits	HD 195034	5699.	0	4.27	1	-0.06	0	5806.
01835.fits	HD 195634	6806.	0	3.52	1	0.00	0	6934.
01840.fits	HD 197076A	5798.	4	4.30	1	-0.17	2	5842.
01841.fits	HD 197076A	5798.	4	4.30	1	-0.17	2	5788.
01844.fits	HD 200375	6579.	0	4.12	1	-0.02	0	6387.
01848.fits	HD 202108	5712.	2	4.20	1	-0.21	2	5698.

Table 2. Continued.

Filename	Star	$T_{\rm eff}$	$Q_{T\rm eff}$	$\log g$	$Q_{\log g}$	[Fe/H]	$Q_{\rm [Fe/H]}$	$T_{\rm eff}$ This work
01850.fits	HD 203839	6888.	0	4.37	1	-0.05	0	6375.
01851.fits	HD 204521	5809.	2	4.60	1	-0.66	2	5586.
01858.fits	HD 206374	5622.	1	4.47	1	0.00	0	5583.
01859.fits	HD 206374	5622.	1	4.47	1	0.00	0	5595.
01864.fits	HD 210460	5386.	3	4.10	1	0.00	0	5476.
01865.fits	HD 210460	5386.	3	4.10	1	0.00	0	5546.
01889.fits	HD 215065	5726.	2	4.00	1	-0.43	2	5621.
01890.fits	HD 215648	6222.	1	4.07	1	-0.30	4	6098.
01891.fits	HD 215704	5418.	2	4.20	1	0.07	2	5437.
01893.fits	HD 216219	5570.	2	3.12	1	-0.41	2	5841.
01894.fits	HD 216385	6219.	4	3.95	1	-0.26	3	6176.
01906.fits	HD 218209	5592.	2	4.25	1	-0.51	2	5541.
01909.fits	HD 218804	6191.	2	4.07	1	-0.28	2	6389.
01912.fits	HD 219396	5733.	2	4.00	1	-0.10	2	5664.
01914.fits	HD 219420	6196.	0	4.21	1	-0.09	0	6152.
01915.fits	HD 219420	6210.	0	4.35	1	0.00	0	6090.
01923.fits	HD 221354	5295.	1	4.52	1	-0.10	0	5282.
01926.fits	HD 221354	5295.	1	4.52	1	-0.10	0	5290.
01927.fits	HD 221354	5295.	1	4.50	1	-0.04	0	5253.
01936.fits	HD 222451	6632.	1	4.30	1	0.13	2	6657.
01939.fits	HD 223323	6375.	1	4.16	1	-0.18	0	6330.
01944.fits	HD 224839	5871.	0	4.19	1	-0.14	0	5887.
01950.fits	HD 32662	6318.	0	4.27	1	0.00	0	6154.
01959.fits	SUN	5777.	4	4.44	1	0.00	4	5773.
01960.fits	SUN	5777.	4	4.44	1	0.00	4	5726.
01961.fits	SUN	5777.	4	4.44	1	0.00	4	5746.
01962.fits	SUN	5777.	4	4.44	1	0.00	4	5751.
01964.fits	SUN	5777.	4	4.44	1	0.00	4	5750.